



**Waterloo Region
District School Board**

REQUEST FOR TENDER

Park Manor Public School – Interior & Window enhancements

Tender #7266-RW-22

ISSUE DATE: February 11, 2022

ELECTRONIC SUBMISSIONS will be received by the Bidding System, no later than 2:00 p.m. local time, on Tuesday, March 1, 2022

1.1 The following professional seals and signatures are provided as required by Paragraph 1.21.1 (4) Division C of the Ontario Building Code and apply to the areas of expertise for which each consultant was commissioned.

1.1.1 Architectural



1.1.2 Structural



1.1.3 Mechanical



1.1.4 Electrical



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1.0 INTRODUCTION

1.1. Single Point of Contact

In relation to this procurement process, all communication shall be directed to:

Rebecca Witteman
Senior Procurement Specialist
Waterloo Region District School Board

All request for information, instructions or clarifications shall be directed to the Single Point of Contact only. Requests should be made through the Bidding System by clicking on the “Submit a Question” button found within the bid detail of the specified Tender.

Vendors shall not communicate with other Waterloo Region District School Board (“Board”) employees or agents regarding this tender prior to award. Any attempt by a Vendor to bypass or influence the procurement process may result in disqualification of their Submission.

The Board will not be responsible for any verbal statement, instruction, or representations. In case of difference between any verbal information and written document, the written document shall govern. Information obtained from any source, other than the Single Point of Contact in writing, shall not be relied upon.

1.2. Consultant

The Board has hired the following consultant to assist in the preparation of this Tender: LGA Architectural Partners.

Addenda will be the Board’s only form of communication. The Board will assemble addenda as required.

The consultant and any sub consultants are not to be contacted by any interested parties from the Tender issue date to the bid award notification. The consultant or any sub consultants will not respond to any direct communication.

The Board will be responsible for the contract administration of the project after the purchase order has been issued or the contract has been signed by the Board

1.3. About the Waterloo Region District School Board

The Waterloo Region District School Board is a provincially funded institution reporting to the Ministry of Education of Ontario and is one of the larger school boards in Ontario, operating 121 school locations and serving approximately 64,000 students in the Region of Waterloo.

1.4. Electronic Bid Submission and Bid Results

All Bids shall be submitted through the Bidding System only. Bidders must have a Bidding System Vendor Account and shall ensure the account is created with the Bidders full legal company name.

Hard copy Bid Submission will not be accepted by the Board.

Bids will not be accepted after the Closing Date and Time.

There will be no public opening for this Tender.

Once an award is made, the successful Bidder will be named on the Bidding System, and an award notification will be sent.

1.5. Bid Submission

- .1 Bidders must include the appropriate submission requirements and mandatory forms specified in this section.
- .2 Bidders shall have a "Vendor Account" in the Bidding System and be registered as a "plan taker" for this Bid Solicitation Document. Only the plan takers will have access to download this Bid Solicitation Document, receive addenda email notifications, download addenda and to submit their Bid electronically through the Bidding System.
- .3 The onus is on the Bidder to ensure that the Bid is received and acknowledged in the Bidding System on or before the Closing Time. The Closing Time shall be determined by the Bidding System's web clock. The timing of the Bid submission shall be based on when the Bid is RECEIVED by the Bidding System, not when a Bid is submitted by a Bidder.
- .4 Bidders shall allow sufficient time to upload their Bid submission and attachment(s) (if applicable) and to resolve any issues that may arise as Bid transmission can be delayed in an "internet traffic jam" due to file transfer size, transmission speed, and other electronic considerations.
- .5 Upon receiving a Bid, the Bidding System will send a confirmation email to the Bidder advising that the Bid was submitted successfully. If a Bidder does not receive a confirmation email despite submitting a Bid, the Bidder should contact technical support of the service provider hosting the Bidding System via email: support@bidsandtenders.ca
- .6 The Bidding System will not accept Bids after the Closing Time as determined by the Bidding System's web clock. Bids submitted by fax or paper copy or any other format will not be accepted.

- .7 The Board hereby consent to the use of an Electronic Signature for the signing of all documents requested hereunder. Acceptable forms of signatures include, but are not limited to, the typing of the Bidder's authorized signing officer's name or the inclusion of an image of the Bidder's authorized signing officer's signature, so long as the electronic signature is sufficient to identify the Bidder's authorized signing officer. The Bidder's authorized signing officer agrees that whatever form of electronic signature is provided constitutes a signature for the purpose of executing all documents requested hereunder.

1.6. Withdrawal of Bid Submission / Irrevocable Period

Bidders may withdraw or edit and resubmit a Bid in the Bidding System at any time prior to the Closing Date and Time. The most recent submission or withdrawal received in the Bidding System on or before the Closing Time shall prevail and shall overwrite all previous submission(s) and withdrawal(s). The Closing Time shall be determined by the web clock within the Bidding System. After such time, requests to withdraw Bid Submissions will not be considered.

Bids will be irrevocable by the Bidder, and open for acceptance by the Board, for **60 (sixty)** days following the Closing Date

1.7. Bid Review

- .1 All Bids received on or before the Closing Time will be reviewed for compliance based on this Bid Solicitation Document. Non-compliant Bids may be rejected. Bids not meeting any of the mandatory requirements included in this Bid Solicitation Document may be disqualified. Bidders may be contacted to clarify its submissions.
- .2 It is the Bidder's responsibility to satisfy the Board that the Bidder can comply with the requirements contained within this Bid Solicitation Document and that the Bidder possesses the necessary inventory, equipment, facilities, resources and staff to perform the Work specified in this Bid Solicitation Document. Bidders may be required to submit evidence of above in a form acceptable to the Board. Substitution of materials, equipment, or methods different from that outlined in the terms of reference will not be accepted unless provided for within this Bid Solicitation Document or with the written approval from the Board.
- .3 The Board also reserve the right to examine Bidder's facilities, equipment and visit the sub-contractors or sub-consultants proposed or Bidder's existing and past clients. The award decision may be revised based on the above.
- .4 The Board will not be responsible for travel costs (including, but not limited to, time and mileage) if travel is required. No additional charges will be accepted by the Board for any cost incurred by the Bidder or any other party in participating in the Bid evaluations.

- .5 The Board may, in their sole discretion, check references, conduct credit checks, review the litigation history and history of professional liability or other insurance claims, and obtain any other type of information that might aid the Board in its selection. The Board reserve the right to consider all or any information received from all available sources, whether internally or externally obtained. The Board may disqualify any Bid from further consideration based on results of reference or credit checks or review of litigation or claim history. The foregoing may include the Board's own experiences with the respective Bidder(s) or any of the subcontractors and sub-consultants proposed in its Bid.

1.8. Tie Bids

Where two (2) or more Bids have been received reflecting the same, compliant lowest Bid price, the time stamp for date and time submission in the Bidding System will dictate the award (earliest submission shall prevail).

1.9. Award Recommendation

- .1 Subject to the reserved rights of the Board and availability of funds, the lowest compliant Bid will be recommended for award.
- .2 The documents listed below will be incorporated as deemed necessary by the Board, into the Contract with the Successful Bidder. If there is a discrepancy between the wording of one document and the wording of any other document that appears on the list, the wording of the document that first appears on the list shall take precedence:
- .3 Board approved change orders or Contract or Agreement amendment.
- .4 Purchase Order, Contract or Agreement executed with the Bidder including exhibits.
- .5 Bid Solicitation Document issued by the Board, including addenda, if applicable.
- .6 Bid submitted by the Bidder.
- .7 There shall be no obligation on the Board as a result of seeking Bids or conducting the procurement process and the Board reserve the right to cancel the Bid Solicitation, issue a revised request, or to pursue any other course of action which would aid in meeting their needs.

1.10. Documents Required for Award

Within ten (10) working days of receiving a request from the Board, the Bidder (the "Recommended Bidder") shall provide the following:

- .1 Insurance certificate with coverage specified in the Bid Solicitation Document.
- .2 WSIB clearance certificate valid on date of award or an exemption letter (if applicable and requested).
- .3 Contract security, if applicable as specified in the Bid Solicitation Document.
- .4 An executed Board issued Form of Agreement, duly signed by the authorized signatory.
- .5 Any other submittal specified in the Bid Solicitation Document as a requirement of award.

In addition to all of the Board' other remedies, if a Recommended Bidder fails to execute the Form of Agreement or satisfy any other applicable conditions within ten (10) days of notice of selection, the Board may, in their sole and absolute discretion and without incurring any liability, rescind the selection of that Bidder.

1.11. Confirmation to Proceed

No work shall commence until each of the Board's Procurement Services has issued a purchase order, contract, or letter of intent to the Successful Bidder. Goods/Service or Work, as described shall not commence until all the required documents have been submitted to Procurement Services and the Form of Agreement executed by the Successful Bidder and the Board. For payment purposes, a Purchase Order shall be generated and issued to the Successful Bidder. The Purchase Order number must appear on all invoices in order to ensure prompt payment.

1.12. Site Visit

Due to Covid-19, Proponents are to supply and wear medical grade masks and eye protection. Due to the nature of this Tender, a NON mandatory site visit has been deemed necessary. Failure to attend and register at the time and location(s) specified would NOT result in disqualification. Representatives for the Proponents are requested to sign in at the NON-mandatory site meet. The Board at its sole discretion may schedule additional non-mandatory site visits. Proponents are to reference 1.8 Timetable for site meet date and time.

The site visit will take place at: Feb 16, 2022 at 3:30pm
The site meet is NON-mandatory for the following: Prime Contractors
Proponents are to meet at the Main Office of Park Manor Senior Public School
at 18 Mockingbird Dr. Elmira, ON. N3B 1T1.

Notify via the "submit a question" feature in this bidding system to the attention of: "Site Meet Request", the name of your company and staff that would like to attend a scheduled site meet.

Do not show up without submitting your request to attend the site meet.

The size of the groups at the site meet(s) will be limited as per current Public Health Recommendations.

An addenda prior to the site meet will be posted noting the companies and personnel and time for each scheduled site meet.

1.13. Supplemental Site Visits

Due to Covid-19, Proponents are to supply and wear medical grade masks and eye protection.

Supplemental site visits will be permitted for interested Proponents and subcontractors to gain access to the site in order to better prepare their bid submission and are not to be held prior to the mandatory or non-mandatory site visit.

When a supplemental site visit is required, the Proponent or subcontractors may only visit the school after 3:30 P.M., during a scheduled school day. The Proponent or subcontractors shall immediately report to the Main Office, sign in as per the school protocol and ask for the head custodian. The head custodian's role is to ensure that the Proponent or subcontractors are guided to the area of interest regarding this Tender document and to provide access where required.

Proponents or sub-trades may not direct any questions related to this Tender to the head custodian or any other Board staff present. Proponents asking the head custodian or Board staff questions related to the scope or Tender in general will be disqualified.

1.14. Communication

For the purpose of this Tender, the only contact for all Bidders, subcontractors if any, and any third-party suppliers of goods or services for all queries, questions and notifications, from the Tender issue date to the bid award notification date is to be directed to the submit a question feature in this bidding system:

1.15. From Issue Date to Deadline for Questions/Queries

Questions must be received by the Board's Single Point of Contact no later than the deadline for questions noted in the Anticipated Project Schedule.

If a Bidder finds any discrepancies, ambiguities or omissions within the Request for Tender (RFT) documents, or requires any clarifications regarding the RFT documents, questions and clarifications must be sent to the Board's Single Point of Contact through the Bidding System by clicking on the "Submit a Question" button found within the bid details page of that opportunity. Bidders are strongly

encouraged to ask clear and concise question(s) citing the relevant section of the Bid Solicitation Document.

The Board has endeavoured to provide complete, correct information and estimates to enable Bidders to properly assess and determine the scope and complexity of the Work prior to submitting a Bid. Bidders are solely responsible for determining if they require additional information or if anything appears incorrect or incomplete. The onus is on the Bidder to contact the Board's Single Point of Contact prior to the Deadline for Questions indicated in this document, if they have any questions or queries whatsoever or find omissions from or discrepancies in this Bid Solicitation document, unnecessary restrictions in the terms of reference, or should they be in doubt as to the meaning of any part of this document. Written answers or clarifications to issues of substance will be shared with all Bidders in the form of an Addendum.

1.16. After the release of the Bid Results Notification / Debriefing Requests

In accordance with the Broader Public Sector Procurement Directive, unsuccessful Bidders are entitled to a debriefing in order to receive feedback with respect to their Bid submission. In order to obtain a debriefing, Bidders shall contact the Board's Single Point of Contact listed in this Bid Solicitation Document in writing with their request within sixty (60) days of the award notification.

1.17. Consequences of not following the Proponent Contact Protocol

Communication initiated by the Proponent, subcontractors, or third-party suppliers of goods or services during the blackout period, to the Board or consultant may be grounds for disqualification from the Tender.

Communication by Proponents, subcontractors, or third-party suppliers of goods or services, to the consultant or the Board, other than the Board contact from the issue date to the Tender to receiving the award non award notification, may be grounds for disqualification from the Tender.

1.18. Anticipated Time Table

The following table represents the anticipated project timelines. This timeline is an estimate only, and may be subject to change by the Board at any time.

DESCRIPTION	DATE
Issue Date	February 11, 2022
Non Mandatory Site Meeting	February 16, 2022. 3:30pm local time
Deadline for Questions	February 23, 2022
Closing Date and Time	March 1, 2022, 2:00 pm local time
Anticipated Contract Start / Work begins	Phased start: May 23 and July 1, 2022
Substantial Completion Date	August 19, 2022
Deemed Complete Date	September 2, 2022

1.19. Blackout Period

A black out period shall exist between the deadline for questions and the date of award. During this period, there shall be no communication between the Bidders, the Board or any Board consultants, unless initiated by the Board' Single Point of Contact.

1.20. Deadline for Questions

Questions must be received by the Single Point of Contact no later than the deadline for questions noted in the Anticipated Project Schedule.

If a Bidder finds any discrepancies or omissions within the Request for Tender (RFT) documents, or requires any clarifications regarding the RFT documents, questions and clarifications must be sent to the Single Point of Contact through the Bidding System by clicking on the "Submit a Question" button found within the bid details page of that opportunity.

The Board shall not be bound by any verbal instruction or information provided by any Board employee or consultant of the Board. Only responses provided in an Addendum shall form part of this Bid Solicitation Document.

1.21. Addenda

All Addenda issued through the Bidding System shall form part of the Tender Document.

Any questions and clarifications regarding the terms of reference shall be requested through the Bidding System by the date noted above. Those that are deemed pertinent to the Tender document will be addressed in the form of an Addendum.

Bidders shall acknowledge the receipt of all Addenda in the Bidding System prior to the submission of their bid. Where Addenda has been issued, the system will not allow the Bidder to submit a bid prior to acknowledging all Addenda.

Where an Addendum is issued after a bid has been submitted, the Bidding System will automatically withdraw the submitted bid. The submission status will change to incomplete and will not be accepted by the Board as a submitted bid. It is the responsibility of the Bidder to acknowledge all Addenda and ensure the bid has been received by the Bidding System. Bidder should check the Bidding System for Addenda up until the closing date and time.

Addenda cannot be acknowledged after the Closing Date and Time.

1.22. Warranty and Maintenance

The Awarded Bidder, at the time of substantial completion shall furnish a written warranty covering material, maintenance, and work performed under the contract for a minimum period of two (2) years from the date of completion. Individual sections may extend warranties beyond the two year time frame. The Awarded Bidder is responsible for all required maintenance complete with materials and labour during the warranty period.

2.0 BOARD PURCHASE ORDER

Goods/Service or Work, as described shall not commence until all of the required documents have been submitted to Procurement Services and the CCDC 2 executed by the Awarded Bidder(s) and the Board. For Payment purposes, a Purchase Order shall be generated and issued to the Awarded Bidder(s). The Purchase Order number must appear on all invoices in order to ensure prompt payment.

3.0 THE BID CONTRACT

.1 The bidders and the Owner acknowledge that it is their intention to create a process contract (the "Bid Contract") between the Owner and any bidder whose Bid meets the Mandatory Requirements. The bidders and the Owner further acknowledge that, if a Bid Contract is created between the Owner and one or more of the bidders, the terms of the Bid Contract are represented by the Bid Documents.

4.0 DEFINITIONS

4.1. Capitalized terms not otherwise defined in this Section or elsewhere in these Instructions to Bidders shall have the meanings ascribed to them in the Contract. All references in these Instructions to Bidders to “Section” or “paragraph” shall, unless specifically indicated otherwise, refer to a Section or paragraph of these Instructions to Bidders.

- .1 **“Bid”** means the Base Bid Form and all other documents submitted by a bidder in accordance with these Instructions to Bidders.
- .2 **“Single Point of Contact”** means the Procurement Specialist of the WRDSB, NOT the prime Consultant.
- .3 **“Bid Documents”** has the meaning set out in item 7, Instructions to Bidders.
- .4 **“Bid Form”** means the Base Bid Form or any of the Supplementary Bid Forms listed in paragraph 6.1.2, section 00 21 13.
- .5 **“Black-Out Period”** is the period between the deadline for asking questions or making queries, to the Bid Award Notification.
- .6 **“Board”** means the Waterloo Region District School Board.
- .7 **“Consultant”** means Prime Consultant retained by the Board and identified in these documents.
- .8 **“Contract”** means the written agreement to be signed between the Owner and the successful bidder in the form of CCDC 2 – 2008 stipulated price contract, as amended by supplementary conditions.
- .9 **“Evaluation Score”** has the meaning set out in item 12.0 Bid Evaluation, Section 00 21 13.
- .10 **“Evaluation Team”** means the committee / team appointed to guide, monitor and direct this bid process and evaluate Bids.
- .11 **“Irrevocability Period”** has the meaning set out in Item 4.2, Section 00 72 13.
- .12 **“Mandatory Requirements”** has the meaning set out in item 12, Section 00 21 13.
- .13 **“Project Manager”** or Project Coordinator can be used interchangeably and is the Board’s representative for the project.
- .14 **“Submission Deadline”** is the date and time identified in Item 1.18, Section 00 21 13.

4.2. VENDORS OF RECORD

- .1 Bidders must be approved as a Vendor of Record by the Owner. Bids received from contractors who have not been approved prior to the Tender period will be returned unopened.
- .2 The Owner reserves the right to issue an addendum naming additional pre-qualified general contractors and additional pre-qualified Subcontractors and Suppliers.

5.0 BID DOCUMENTS

- .1 The following documents form the basis of this bid process (collectively the “Bid Documents”):
 - .1 Instructions to Bidders.
 - .2 Bid Forms comprising the Base Bid Form and, where required, the Supplementary Bid Form – List of Subcontractors, Supplementary Bid Form – Itemized, Separate and Alternative Prices, and Supplementary Bid Form – Unit Prices.
 - .3 CCDC 2 – 2008 stipulated price contract comprised of the Agreement Between Owner and Contractor, Definitions, and General Conditions of the Stipulated Price Contract.
 - .4 Supplementary Conditions.
 - .5 Specifications (as per table of contents).
 - .6 Drawings (as per list of Drawings).
 - .7 Any Reports or Studies, including, but not limited to, Asbestos, Hazardous Materials and Sub-Surface soil conditions included with the specifications or addenda.
 - .8 Addenda issued prior to the Submission Deadline.
- 5.2. Check Bid Documents for completeness upon receipt. Inform the Board’s Single Point of Contact immediately, should any documents be missing or incomplete and/or upon finding any discrepancies or omissions.
- 5.3. The Bid Documents are made available only for the purpose of submitting Bids for the Project. Availability and/or use of the Bid Documents do not confer a license or grant for any other purpose.
- 6.0 **PROHIBITION ON LOBBYING / COLLUSION**
- 6.1. Bidders and/or any representatives employed or retained by them are strictly prohibited from engaging in conduct which is or could reasonably be considered as any form of political or other lobbying, or as an attempt to influence the outcome of this bid process.
- 6.2. A bidder shall not discuss or communicate directly or indirectly with any other bidder any information whatsoever regarding the preparation of a Bid. Bidders shall prepare and submit Bids independently and without any communication, knowledge, comparison of information, or arrangement, direct or indirect, with any other bidder.
- 6.3. Failure of any bidder to comply with this Section may result in the disqualification of the bidder and the rejection of its Bid.

7.0 CONFLICT OF INTEREST

7.1. Bidders shall disclose all perceived, potential and actual Conflicts of Interest. For the purposes of this bid process, "Conflict of Interest" includes:

- .1 any situation or circumstance where, in relation to this bid process and/or the Contract, the bidder's other commitments, relationships or financial interests could or could be perceived to exercise an improper influence over the objective, unbiased and impartial exercise of independent judgment by any member of the Evaluation Team, the Board, or the Owner;
- .2 any situation or circumstance where any person(s) employed by the Owner in any capacity, or any member of the Board:
 - .1 has a direct or indirect financial interest in the award of the Contract to any bidder;
 - .2 is currently employed by, or is a subcontractor or a consultant to a bidder;
 - .3 is negotiating or has an arrangement concerning future employment or contracting with any bidder;
 - .4 has an ownership interest in, or is an officer or director of, any bidder.

7.2. If a bidder discovers, at any time, any perceived, potential or actual Conflict of Interest, the bidder shall promptly disclose the perceived, potential or actual Conflict of Interest by sending a written statement in the manner described in paragraph 8. Failure of any bidder to comply with this Section may result in the disqualification of the bidder and the rejection of its Bid.

7.3. Without limiting the generality of Section 22, the Owner may, in its sole discretion:

- .1 exclude any bidder and its Bid on the grounds of Conflict of Interest;
- .2 waive any and all perceived, potential or actual Conflicts of Interest upon such terms and conditions as the Owner, in its sole discretion, requires to satisfy itself that the Conflict of Interest has been appropriately managed, mitigated and minimized.

8.0 SITE INVESTIGATION

- .1 Any soils investigation, environmental, geotechnical or other reports prepared or obtained with respect to the Place of the Work (collectively the "Reports") are available from the Consultant. Where the Work involves existing buildings, structures, facilities, plant or equipment, any reports, data or as-built drawings concerning such buildings, structures, facilities, plant or equipment (collectively the "Data") are available from the Consultant. The Reports should not be considered a representation of the site conditions of the entire Place of the Work, and the Reports and Data are provided for general information and guidance purposes only. Neither the Owner nor the Consultant guarantees the accuracy or completeness of the Reports or the Data.

- Data, nor does either assume any responsibility for any interpretations or conclusions that bidders may make or draw from the Reports or the Data.
- .2 Each bidder is solely responsible, at its own cost and expense, to carry out its own independent research and due diligence, or to perform any other investigations considered necessary by the bidder to satisfy itself as to all existing conditions, circumstances and limitations affecting the Work, including the existence and/or locations of utilities and underground services. The bidders' obligations set out in this paragraph apply irrespective of any Reports, Data or any information contained in the Bid Documents.
 - .3 No allowances will be made for additional costs and no claims will be entertained in connection with conditions which could reasonably have been ascertained by investigation or other due diligence undertaken prior to the Submission Deadline, and/or in connection with Work which is required and which is reasonably inferable from the Bid Documents, the Reports and/or Data as being necessary.

9.0 DESIGNATED SUBSTANCES

1. Asbestos Audit, prepared by MTE Consultants Inc. for each facility is available in the tender package as well as at the school's main office. A duplicate set is also available in the Facility Services department located at the Education Centre. Unless otherwise specifically covered by Cash Allowance or Contingency Allowance for known asbestos materials, include in this contract for the removal under abatement, in compliance with O.Reg. 278/05, of all known asbestos containing materials, as identified in the audit, within 600mm of all new services, materials, and equipment, and/or as required to complete the work. No claims for extra cost will be accepted for areas known to contain asbestos containing materials.
2. Comply with applicable legislation regarding asbestos. Should the Contractor encounter asbestos, not noted in the above Asbestos Audit, that would be disturbed during the course of the Work they should stop the work in that immediate area and report the same to the Board Contact.
3. Preliminary paint samples were collected within the work area to determine if lead-based paints are present. The analytical results are available in the tender package along with a Designated Substance Report (DSR) (for lead paint), where lead-based paints were identified or were deemed highly suspected.
4. Disturbance or demolition of lead-based paints, surface coatings, sheetings, mortar, piping or solders shall be conducted by the Contractor in accordance with the procedures noted in the Environmental Abatement Council of Canada (EACC) "Lead Guideline" (October 2014) and/or the Ministry of

Labour (MOL) "Lead on Construction Projects" guideline (April 2011). The extent of procedures required depends on the type of work to be conducted.

5. In addition to asbestos and/or lead, silica, and mercury are present in all WRDSB facilities. New construction, renovations or alterations require compliance by the Contractor with the applicable legislation. Other designated substances (i. e. acrylonitrile, arsenic, benzene, coke oven emissions, isocyanates, ethyl oxide, and vinyl chloride) are not encountered in WRDSB facilities as significant constituents or in a form that would represent an exposure concern.
6. Examples of common building materials that are considered as containing the additional designated substances are listed below:
 1. Lead - paints and coatings, lead sheeting, pigment mortar, lead piping, lead solder and fittings. In addition to the procedures outlined for lead paint and coatings in the DSR, the Contractor shall inform all workers of the presence of paint finishes that are lead containing. Disturbance of lead-containing paints or surface coatings shall be conducted in accordance with the procedures outlined in the Environmental Abatement Council of Canada (EACC) "Lead Guideline" (October 2014) and/or the Ministry of Labour (MOL) "Lead on Construction Projects" guideline (April 2011). The extent of procedures required depends on the type of work to be conducted. Carefully demolish and recycle of any lead sheeting, piping, solder and fittings. Waste to be handled and disposed of in accordance with O.Reg. 347. Contractor to ensure workers use appropriate PPE and follow the appropriate methods for removal stipulated by the MOL Lead on Construction Guidelines.
 2. Silica - concrete, brick, stone, terrazzo, refractory brick as well as in plaster drywall, acoustic ceiling tiles, drywall joint compound, mortars, and adhesives in low concentrations. All work involving the demolition silica-containing materials shall follow the procedures outlined in the MOL "Silica on Construction Projects" guideline. Type 1 operations may be necessary based on the type of work conducted and the Contractor shall implement dust suppression methods and protect workers.
 3. Mercury - thermometers, barometers, thermostats, gauges, electrical switches, and lighting products including fluorescent light bulbs and a variety of High Intensity Discharge (HID) lamps as mercury vapour, metal halide and high pressure sodium lamps. Lamps and other devices that require demolition are to be handled with care and kept intact to avoid potential exposure. Any mercury-containing lamps or other equipment that are demolished are to be recycled. Waste to be handled and disposed of in accordance with O.Reg. 347.

10.0 INSTRUCTIONS FOR COMPLETING THE BID

10.1. Listing of Subcontractors:

- .1 Where required by the Bid Documents, bidders shall complete and submit a Supplementary Bid Form – List of Subcontractors, naming the Subcontractors and Suppliers which the bidder will employ to perform an item of the Work called for by the Contract. Failure of the bidder to list Subcontractors and Suppliers, where required, may result in the Bid being declared non-compliant.
- .2 Where the Owner has provided a Vendor of Record list, for any one or more Subcontractors and/or Suppliers to perform or supply an item of the Work called for by the Contract, bidders shall select a subcontractor or supplier from that Vendor of Record list to perform or supply that item of Work. Failure to do so shall result in the Bid being declared non-compliant.
- .3 Where a bidder lists more than one Subcontractor or Supplier to perform or supply an item of the Work listed, the Subcontractor or Supplier that is listed last shall be deemed to be the Subcontractor or Supplier to be employed by the bidder to perform or supply such item of the Work.
- .4 Where a bidder lists “own forces” in place of a Subcontractor, the bidder shall carry out such item of the Work with its own forces. Where “own forces” have been listed by a bidder, the Owner reserves the right to obtain information from the bidder and from third parties respecting the qualifications and experience of the bidder’s “own forces” for such item of the Work.

10.2. Itemized, Separate and Alternative Prices:

- .1 Where required by the Bid Documents, bidders shall complete and submit a Supplementary Bid Form – Itemized, Separate and Alternative Prices. The Owner reserves the right to accept or reject any or all itemized, separate and alternative prices submitted, and such prices shall remain in effect for the duration of the Contract. Failure to submit an itemized, separate or alternative price where required may result in the Bid being declared non-compliant.

10.3. Unit Prices:

- .1 Where required by the Bid Documents, bidders shall complete and submit a Supplementary Bid Form – Unit Prices. Unit prices shall be in effect for the duration of the Contract and may be used to calculate the cost of additional work under the Contract. The Owner reserves the right to accept or reject any or all unit prices submitted, and such prices shall remain in effect for the duration of the Contract. Failure to submit a unit price where required may result in the Bid being declared non-compliant.

11.0 BID EVALUATION

- 11.1. Mandatory Requirements.** Only bidders that submit Bids which the Evaluation Team determines meet all of the mandatory requirements set out below (collectively the “Mandatory Requirements”) on a “pass/fail” basis will be eligible to be considered for an award of the Contract:
- .1 The Bid includes the Base Bid Form which bears the bidder’s original signature.
 - .2 The bidder is a valid Vendor of Record.
 - .3 Where a mandatory site meeting was scheduled and held, the bidder attended the mandatory site meeting.
 - .4 The Bid includes the Security Documents.
 - .5 The Bid includes valid Vendor of Record Subcontractors and/or Suppliers.
 - .6 The Bid substantially complies with the other requirements of the Bid Documents.
- 11.2. Point Based Evaluation Criteria.** Only Bids which meet all of the Mandatory Requirements will be evaluated by the Evaluation Team and awarded points based on criteria set out below.
- .1 As few as zero (0) points will be awarded for each evaluation category; the maximum points available for each evaluation category are set out below.
 - .2 The total points awarded to a bidder will be that bidder’s “Evaluation Score”.

CRITERIA	Points Available
<i>Mandatory bid documents</i>	Pass/Fail
Bid price offered / bid price as adjusted by the amount of any itemized, separate and/or alternative price(s) which the Owner, in its discretion, decides to accept.	100%
MAXIMUM POINTS AVAILABLE	100

12.0 AWARD OF THE CONTRACT, DOCUMENTS TO BE DELIVERED, AND EXECUTION OF THE CONTRACT

- 12.1.** Within ten (10) Working Days of receiving an award letter from the Owner, and prior to commencing the Work, the successful bidder shall deliver to the Owner:
- .1 the performance bond and the labour and material payment bond described in the Bid Documents, the forms of such bonds to comply with the requirements of the Contract;
 - .2 certified true copies of the insurance policies required by the Contract or certificates of insurance, at the option of the Owner;

- .3 a current WSIB clearance certificate;
- .4 the bidder's health and safety policy for the Project; and
- .5 a copy of the notice of project issued by the Ministry of Labour for the Project.

12.2. The successful bidder shall execute the Contract and shall deliver the executed original to the Owner within ten (10) Working Days of the bidder's receipt of the same.

13.0 PUBLIC STATEMENTS, CONFIDENTIALITY, AND MFIPPA

13.1. Bidders shall not publish, issue or make any statements or news release, electronic or otherwise, concerning their or any other Bid, this bid process, the evaluation of the Bids, the award of the contract, or cancellation of this bid process, without the express written consent of the Owner. The Owner's award of the Contract to a bidder does not constitute a general endorsement of that bidder's products or services.

13.2. All information provided by or obtained from the Owner in connection with this bid process is the sole property of the Owner and must be treated as confidential. Such information is not to be used for any purpose other than preparing a Bid.

13.3. By submitting a Bid, bidders acknowledge that the contents of their Bids will be disclosed, on a confidential basis, to the Evaluation Team and may be disclosed to members of the Board and the Owner's staff, agents and advisors for the purpose of evaluating or participating in the evaluation of the Bids. The Owner will use reasonable efforts to protect pricing, commercial terms, and other sensitive and confidential information provided by the bidders as part of a Bid (the "Confidential Material"), however, the Owner accepts no liability in the event that the Confidential Material, or any part of it, is disclosed even if the Evaluation Team, the Owner, its staff, agents, advisors or any other person associated with the Board or the Owner may have been negligent with respect to such disclosure.

13.4. Information provided in the Bids may be presented at public meetings of the Board and may be disclosed to the public. In addition, the Owner may be required to disclose information provided in the Bids pursuant to the provisions of the Municipal Freedom of Information and Protection of Privacy Act or other legislation. By submitting a Bid each bidder agrees to such disclosure and releases the Evaluation Team, the Owner, the Board, and the Consultant from any liability for the same.

14.0 RELEVANT POLICIES

- .1 The Board has a number of relevant policies regarding tenders and bidders should familiarize themselves with the following policies:

- .1 Purchasing Policy- www.wrdsb.ca/about-the-wrdsb/procurement-services
- .2 Conflict of Interest - Employees or Trustees - <https://www.wrdsb.ca/wp-content/uploads/4005-Procurement.pdf>
- .3 Acceptance of Hospitality or Gifts - <https://www.wrdsb.ca/wp-content/uploads/4005-Procurement.pdf>
- .4 The Board also has emergency response procedures: - www.wrdsb.ca

END OF SECTION

SECTION 00 21 14 – VENDORS OF RECORD

1.0 INTRODUCTION

- 1.1. The **Waterloo Region District School Board**, in an effort to build an improved supplier database and to obtain exceptional long term value, has implemented a Vendors of Record list. This tender is open to those who are currently registered under the Board's Vendor Registration System.
- 1.2. Only those General Contractors and Subcontractors noted below may submit bids in their particular fields. Refer to specification sections for products, suppliers and installers that will be required in addition to the Vendors of Record noted below.

2.0 VENDOR REGISTRATION PROCESS

- 2.1. To become a Vendor of Record for future business opportunities, go to the Board's public website at www.wrdsb.ca and refer to *About Us - Purchasing Services - Vendor Registration*, and submit the completed application, as per instructions on the website.

3.0 PRIME / GENERAL CONTRACTORS

- 3.1. Any bid submission from bidders other than Vendors of Record contractors listed below or identified by Addendum will have their bid ruled informal.
- 3.2. The Owner reserves the right to issue an addendum naming additional general contractors as a Vendor of Record.
- 3.3. The following Prime / General Contractors are Vendors of Record with the Board and are invited to submit bids:

General Contractor	Phone	Email
Bestco Construction (2005) Ltd	(905) 304-4597	estimating@bestcoconstruction.com
Caird-Hall Construction Inc.	(905) 634-0903	caird-hall@bell.net
Collaborative Structures Limited	(519) 658-2750	jblackler@collaborativestructures.com
Complete Building Systems Inc.	(519) 576-5800	estimating@completebuildinsystems.ca
CRD Construction	(519) 822-1801	sbock@crdconstruction.on.ca
D. Grant Construction Limited	(519) 652-2949	swillis@dgrantconstruction.com
Dakon Construction	(519) 746-0920	james@dakon.ca
Eldale Structures Ltd	(519) 823-5500	bmcleod@eldale.com
Elgin Contracting and Restoration Ltd.	(519) 633-9969	info@elgincontracting.com

Gateman-Milloy Inc.	(519) 748-6500	info@gatemanmilloy.com
Golden Gate Contracting Inc	(905) 844-1122	estimation@ggcontracting.ca
K&L Construction (Ontario) Ltd	(519) 472-7164	todd.hodgins@kandlconstruction.com
Melloul Blamey Construction	(519) 886-8850	teresa.oreilly@melloul.com
Nith Valley Construction Ltd	(519) 662-1324	mail@nithvalley.com
PM Contracting Ltd	(519) 576-8327	sarahziegler@pm.on.ca
Pre-Eng Contracting Ltd.	(905) 738-6866	info@pre-eng.com
Reid & Deleye Contractors Ltd	(519) 688-2600	gregd@reid-deleye.com
RENOKREW	(416) 604-7042	info@renokrew.com
SG Cunningham Ltd	(519) 886-2730	allan@cunningham.on.ca
Sierra Construction	(519) 421-7413	info@sierraconstruction.ca
SPEC Construction Inc.	(519) 650-4030	info@spec-build.com
STM Construction Ltd	(519) 756-7030	robertbox@stmconstruction.com
Struct-Con Construction Ltd.	(905) 791-5445	harpreet@struct-con.ca
Tambro Construction	(519) 766-1234	btami@tambro.com
TRP Construction	(905) 336-1041	info@trpconstruction.ca
Van Horne Construction Ltd	(905) 677-5150	otekin@vanhorne.ca
Zehr Levesque Inc.	(519) 576-2233	estimating@zehrgroup.ca

4.0 SUBCONTRACTORS

- 4.1.** Bidders shall select only a Subcontractor or Supplier listed below to perform or supply an item of Work indicated. Failure to do so shall result in a Bid being ruled informal.
- 4.2.** The Owner reserves the right to issue an addendum naming additional Subcontractors and Suppliers as a Vendor of Record.
- 4.3.** The following Subcontractors are Vendors of Record with the Board and are invited to submit bids to the General Contractors:

Mechanical Contractor	Phone	Email
AAA Air Conditioning Inc	(519) 747-9051	igrant.aaaac@gmail.com
AIM Industrial Inc.	(519) 747-2255	craigd@aimindustrial.ca
Arcadian Projects Inc.	(519) 804-9697	cory@arcadianprojects.ca
Black & McDonald Limited	(905) 560-3100	sfernandes@blackandmcdonald.com

Brenner Mechanical Inc	(519) 746-0439	clanglois@brenner.ca
C.N. Mechanical Contractors Limited	(519) 404-8235	mclaughlin5284@rogers.com
CJ's Express Plumbing & Electrical	(519) 621-3111	noliveira@cjsexpress.ca
Conestogo Mechanical Inc	(519) 579-6740	wquickfall@conestogomech.com
Dean Lane Contractors Inc	(519) 585-0903	dean@dean-lane.com
Dordan Mechanical Inc.	(519) 662-9900	danielg@dordanmech.com
Jas 3 Limited	(519) 741-8643	jeffs@jas3heatingcooling.ca
Jay Stewart Mechanical	(519) 576-2663	admin@jaystewart.ca
Keith's Plumbing & Heating Inc.	(905) 544-8118	andrena@keithsph.com
LJ Barton Mechanical Inc.	(905) 304-1976	estimating@ljbarton.com
Nelco Mechanical Ltd	(519) 744-6511	mhobson@nelcomech.com
Reitzel Heating & Sheet Metal	(519) 884-3510	alan@reitzelheating.ca
Roberts Bros Sheet Metal Contractors Ltd.	(519) 633-1507	robertsbros@bellnet.ca
Roberts Onsite Inc	(519) 578-2230	dmagnus@robertsonsite.ca
SCT Mechanical Inc.	(519) 626-0268	jscott@sctmechanical.com
Sutherland-Schultz Ltd	(519) 653-4123	info@sutherland-schultz.com
Touchstone Building Technologies Inc.	(519) 997-2792	info@touchstonebti.ca
Trade Mark Industrial Inc	(519) 570-1511	tmoore@trade-markind.com
Velocity Mechanical Inc	(519) 896-1119	quotes@velocitymechanical.com
Vollmer Inc.	(519) 966-6100	mshaw@vollmer.ca
Wellington Plumbing & Heating Ltd.	(519) 821-4130	kyle@wellington-plumbing-hvac.com
Yorktowne Air Inc.	(905) 532-9699	klipien@yorktowneair.ca

Electrical Contractor	Phone	Email
AIM Industrial Inc.	(519) 747-2255	craigd@aimindustrial.ca
Arcadian Projects Inc.	(519) 804-9697	cory@arcadianprojects.ca
Atlas Electric Corp.	(289) 386-3601	atlaselectricgta@gmail.com
Boshart Electric Ltd.	(519) 662-1220	patf@boshartelectric.com

CJ's Express Plumbing & Electrical	(519) 621-3111	noliveira@cjsexpress.ca
D&D Electric Ltd	(519) 603-2924	jquehl@ddelectric.ca
Eby Electric Inc.	(519) 635-7642	todd@ebyelectric.com
Eclipse Technology Solutions Inc.	(905) 593-1770	jbacon@eclipsetechnology.ca
Edge Electrical Solutions Inc.	(519) 747-3343	Kevin@EdgeElectricalSolutions.ca
Fairway Electrical Services Incorporated	(905) 304-1133	cherd@fairwayelectrical.com
Harold Stecho Electric Ltd	(519) 746-0047	steves@stechoc.ca
JM Electrical Contracting	(519) 572-3148	johnmader@sympatico.ca
Juno Electric	(519) 821-4890	steno@junoelectric.ca
KW E Inc Electrical Contractors	(519) 653-6989	jim@kweinc.com
Live Electric	(519) 265-8566	estimates@live-electric.ca
Millers Electric Ltd	(519) 742-3465	scottg@meltd.on.ca
MJM Electric Limited	(519) 824-1989	mlang.mjm@gmail.com
Nadelec Contracting Inc	(905) 875-5239	john.nadelec@gmail.com
Nelco Mechanical Ltd	(519) 744-6511	mhobson@nelcomech.com
Pfaff Electric Limited	(519) 235-0909	jeff@pfaffelectric.com
Roberts Onsite Inc	(519) 578-2230	dmagnus@robertsonsite.ca
Sentry Electric Inc	(705) 436-4530	info@sentryelectric.ca
Sutherland-Schultz Ltd	(519) 653-4123	info@sutherland-schultz.com
Toth Inc	(519) 696-3916	tothelectric@rogers.com
Trade Mark Industrial Inc	(519) 570-1511	tmoore@trade-markind.com
Trade Service Group Inc.	(519) 591-8851	mikewernie@tradeservicegroup.com
Vollmer Inc.	(519) 966-6100	mshaw@vollmer.ca

Plumbing Contractor	Phone	Email
Advantage Mechanical Services	(226) 338-2911	advantage_mechanical@live.ca
BCG Electrical/Pro Plumbing (a Lancaster Group Company)	(519) 304-8411	trankin@lancastergroup.ca
Brenner Mechanical Inc	(519) 746-0439	clanglois@brenner.ca
C.J. Brubacher Ltd	(519) 669-3362	kyle@cjbrubacher.com

C.N. Mechanical Contractors Limited	(519) 404-8235	mclaughlin5284@rogers.com
Conestogo Mechanical Inc	(519) 579-6740	wquickfall@conestogomech.com
Dave Hurst Plumbing	(519) 893-3464	dispatch@hurstplumbingheating.com
Dean Lane Contractors Inc	(519) 585-0903	dean@dean-lane.com
Dordan Mechanical Inc.	(519) 662-9900	danielg@dordanmech.com
Jay Stewart Mechanical	(519) 576-2663	admin@jaystewart.ca
Keith's Plumbing & Heating Inc.	(905) 544-8118	andrena@keithsph.com
LJ Barton Mechanical Inc.	(905) 304-1976	estimating@ljbarton.com
Naylor Building Partnerships Inc.	(905) 338-8000	bbrouwer@naylorbp.com
Nelco Mechanical Ltd	(519) 744-6511	mhobson@nelcomech.com
PPL Aquatic Fitness and Spa Group Inc.	(905) 501-7210	bbryson@pplgroup.com
Roberts Bros Sheet Metal Contractors Ltd.	(519) 633-1507	robertsbros@bellnet.ca
Roberts Onsite Inc	(519) 578-2230	dmagnus@robertsonsite.ca
Sutherland-Schultz Ltd	(519) 653-4123	info@sutherland-schultz.com
Trade Mark Industrial Inc	(519) 570-1511	tmoore@trade-markind.com
Van Dam Mechanical Contracting Inc	(519) 571-1844	edv@vandammech.ca
Velocity Mechanical Inc	(519) 896-1119	quotes@velocitymechanical.com
Vollmer Inc.	(519) 966-6100	mshaw@vollmer.ca
Wellington Plumbing & Heating Ltd.	(519) 821-4130	kyle@wellington-plumbing-hvac.com

Abatement Contractor	Phone	Email
A & O Contracting Inc	(905) 828-6868	anthony@aandocontracting.com
Azbest Environmental	(226) 751-5059	hank@azbest.ca
Biggs & Narciso Construction	(905) 470-8788	james@biggsandnarciso.com
Caliber Environmental Construction Services Inc.	(905) 884-5500	jimball@caliberenv.com
EAN Construction	(519) 603-0109	info@eanconstruction.com
Enviro-cor Enterprises	(519) 753-0993	kelly@enviro-cor.ca
FPR Environmental Inc	(519) 568-8222	frank@asbestosmouldexperts.com

GB Environmental Services	(905) 984-3455	gflett@gbenvironmental.net
I&I Construction Services Ltd	(905) 884-1290	tbarron@iandi.ca
Jobi Construction Ltd.	(519) 227-1181	bparsons@jobiconstruction.com
Power Environmental Power Vac	(905) 318-0622	info@powervachamilton.ca
Puroclean Property Restoration	(519) 653-8030	jreis@puroclean.com
Reitzel Bros. Environmental	(519) 648-2237	ddeleon@ags-environmental.com
Schouten Environmental Inc	(519) 577-8989	brant@schouten.ca
Zero Environmental Inc.	(519) 772-5500	info@zeroenvironmental.com

Masonry Contractor	Phone	Email
1138483 On Ltd Bender Construction	(519) 323-2742	info@benderconstruction.ca
Advanced Masonry Inc	(519) 846-2121	dkocher@advancedmasonry.ca
Blockwall Masonry Ltd	(905) 669-0033	blockwall@bellnet.ca
Brownstone Masonry	(905) 856-3115	brownstonemason@bellnet.ca
Core Tec. Contracting	(519) 620-7100	eddy@coretec.ca
Elgin Contracting and Restoration Ltd.	(519) 633-9969	info@elgincontracting.com
G & B Masonry Ltd	(519) 220-8437	matt@gandbmasonry.ca
GA Masonry	(519) 648-2285	bgeorge@gamasonry.com
J.V.H. Masonry Ltd.	(905) 479-2959	jvhmasonry@rogers.com
Jeffrey Custom Masonry Ltd.	(519) 275-1279	brad_jeffrey@wightman.ca
Konia Masonry Corp.	(519) 664-1112	main@koniamasonry.com
R Dekoninck Masonry Inc.	(519) 582-3003	rdekoninckmasonry@gmail.com

Millwork Contractor	Phone	Email
Baywood Interiors Ltd	(519) 748-9577	johnl@baywoodinteriors.com
Bendt Kitchens and Millwork Inc.	(519) 743-7418	jody@bendt.ca
BEZ Industries	(519) 579-3880	john@bezindustries.com
CCW Inc	(519) 886-2728	hermes.alvarez@ccwinc.com
DM Millwork Ltd	(519) 743-1556	dmmillwork@gto.net
GL Industries Ltd	(519) 787-4379	gary@glindustries.ca

Leedwood Ltd.	(519) 805-3556	ryan@leedwood.ca
Second Generation Furnishings	(905) 738-1403	robert@2ndgen.ca
Top Millwork Interiors Inc.	(416) 736-9868	topmillwork@msn.com
Vdcm Architectural Woodwork Inc.	(519) 743-4409	estimating@vdc.ca
Wood Design Ltd	(905) 595-1281	wooddesign.ltd@gmail.com

Window Install Contractor	Phone	Email
Aerloc Industries Ltd.	(905) 628-6061	peterdendekkerjr@aerloc.com
Alwind Industries Ltd	(905) 738-4266	gm@alwind.com
Barton Glass	(905) 385-3599	pdhbartonglass@quickclic.net
Festival City Glass Ltd.	(519) 271-5182	festivalcityglass@gmail.com
Glass Canada Limited	(519) 642-4100	rdamstra@glass-canada.com
Kitchener Glass Ltd	(519) 744-5201	paul@kitchenerglass.com
KW Glass Systems Inc	(519) 725-9305	rick@kwglass.com
Peninsula Glass Inc.	(905) 735-2901	tim@peninsulaglass.ca
Shantz Windows	(519) 669-2629	bruce@shantzwindows.com
Sherwood Windows Group	(416) 675-3262	bhorton@sherwoodwindows.com
Windspec Inc	(905) 738-8311	wferri@windspec.com

Flooring Contractor	Phone	Email
Flooring Plus	(519) 747-5131	vartan@flooringplus.ca
M&M Carpet Inc.	(905) 279-7875	mmcarpet@bellnet.ca
Nufloors Simcoe	(519) 426-2619	garnatfloor@eastlink.ca
Rick's Carpet and Flooring	(519) 449-2362	gcouwenberg@rickscarpet.ca
S L Marcella Carpets Ltd	(519) 885-2357	nick@marcellacarpets.ca
The Belluz Group Ltd.	(905) 385-8999	abraham@belluzgroup.ca
Twin City Tile Co Ltd	(519) 743-4179	matt@twincitytile.com
Voll's Contract Flooring	(519) 669-1151	dkirch@vollscontract.ca
Zet Master Limited	(905) 789-6560	konrad@zetmaster.com

Painting Contractor	Phone	Email
Aves & Shaw Painting	(519) 742-3486	avesandshawltd@rogers.com
CertaPro Painters of Waterloo	(519) 616-1167	adyck@certapro.com
Expert Painting Inc	(519) 635-8106	expertpainting@hotmail.com
Gateway Painting Ltd.	(519) 500-0772	info@gwpainting.ca
Mike McMahon's Painting Ltd	(519) 744-0169	mikes.painting.ltd@sympatico.ca
Northern Painters (div Connco Group Ltd)	(800) 465-6985	northpaint@conncogroup.com
Platinum Painting & Decorating Inc.	(905) 790-2111	sandro@platinumpaintdecor.com
Westwood Painting Services Inc.	(905) 575-8458	westwoodpainting@cogeco.net

END OF SECTION



**Waterloo Region
District School Board**

Appendix B – Price Bid Form Sample

Instructions: Bid price shall be submitted through the Bidding System only

SCHOOL	BID PRICE	HST	TOTAL
	\$	\$	\$
	\$	\$	\$
	\$	\$	\$

SAMPLE

END OF SECTION

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Appendix D - VENDOR PERFORMANCE EVALUATION FORM AND GUIDELINES

The Board, in an effort to build an improved supplier base and to obtain exceptional long term value, has undertaken a project to register vendors. In conjunction, performance of vendors, either Prime and/or Sub that are involved with this project may be evaluated.

The evaluation may occur at or near substantial completion.

An evaluation may also occur at any stage of the project in order to request and implement a corrective action to facilitate the successful completion of the project.

The Board will evaluate prime contractors.

Prime contractors will evaluate sub-contractors that do not meet expectations and forward the results to the Board. The Board will initiate a request for corrective action to the subcontractor. This is separate from any corrective action that the prime contractor may have. Prime contractors may address the evaluation form and processes at the start up meeting, but it is the responsibility of the prime contractor and the subcontractors to communicate, understand and adhere to the evaluation form and guidelines.

The Board will forward Performance Evaluations to the evaluated prime contractor and/or Subcontractor, here after referred to as Vendor.

A Vendor Performance Evaluation that:

1) Meets or exceeds expectations:

Is a very powerful tool that the evaluated vendor can forward as references to prospective clients giving a very accurate indication of their performance and abilities.

As such, upon request, a vendor performance evaluation will be completed and forwarded to the same vendor, who can then forward it on to their prospective client.

2) Is below expectations:

Will be forwarded to the vendor with a Request for Corrective Action.

The Board will also lower the project size capability of the vendor at this time.

Upon the vendor's successful completion and demonstration of the Request for Corrective Action, the Board may increase the project size capability of the vendor.

The Board or vendor upon the successful completion of the Request for Corrective Action may request a meeting in order to move forward in a positive manner.

Procurement Services will provide clarification and/or direction regarding the Request for Corrective Action, if requested, however the Vendor Performance Evaluation will remain as issued.

The Vendor Performance Evaluation, Requests for corrective action, and the vendor's corresponding corrective action will be filed at the Board.

The Vendor Performance Evaluation may be revised and or modified at any time without notice.



Business Services Division

Procurement Services

VENDOR PERFORMANCE EVALUATION

Vendor Name: _____

Project Name: _____

Tender Number: _____

Classification: Prime Contractor Subcontractor

CHECK ONE					
Not Applicable	Far below expectations: inadequate, containing little detail insufficient knowledge	Does not fully meet expectations: limited knowledge and requirements	Meets expectations: demonstrates ability and knowledge to address basic requirements	Exceeds expectations: demonstrates clear, concise knowledge of requirements	Far exceeds expectations: highly comprehensive, excellent response

1. **Safety & Security:** (Understands & follows requirement guides)
Comments: _____

	1	2	3	4	5
--	---	---	---	---	---

2. **Site Supervision:**
Comments: _____

	1	2	3	4	5
--	---	---	---	---	---

3. **Billing Accuracy:**
Comments: _____

	1	2	3	4	5
--	---	---	---	---	---

4. **Ability to Minimize Deficiencies:**
(Timing, follow up, documentation of actions)
Comments: _____

	1	2	3	4	5
--	---	---	---	---	---

5. **Ability to Maintain Schedule & React to Changes:**
(Completeness of work, providing appropriate manpower)
Comments: _____

	1	2	3	4	5
--	---	---	---	---	---

6. **Ability to stay focused on Scope:** (Does not seek additional work)
Comments: _____

	1	2	3	4	5
--	---	---	---	---	---

7. **Approximate dollar value evaluated:**

0-50,000	50,000. – 500,000.	500,000. +
----------	--------------------	------------

8. **Additional Comments:** _____

Score: _____

General Contractor: _____ Date: _____
(If evaluating subcontractor) (company name) (Project Manager) (signature)

Project Evaluator: _____ Date: _____
(print name) (signature)

Manager: _____ Date: _____
(print name) (signature)

Procurement Services action taken: File Corrective Action (overall average score <3/individual score<3)

Procurement Manager: _____ Date: _____
(or designate) (print name) (signature)

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SECTION 00 41 73 - SUPPLEMENTARY BID INFORMATION

If requested, the **Supplementary Bid Information** must be completed and submitted at time of the tender closing. **All pricing where requested in this form is plus HST.**

GENERAL CONTRACTOR

1.1 The following personnel will be assigned to manage and supervise the Work. Personnel will be subject to approval by the Board, and cannot be changed without prior written approval from the Board.

Site Supervisor: _____

Project Manager: _____

Part 2 ALTERNATIVE PRICES

2.1 The following are the prices for the alternative work listed hereunder. Such Alternative Work and amounts are NOT included in the Bid Price.

ITEM	ADDITION TO THE BASE BID PRICE	DEDUCTION TO THE BASE BID PRICE
Alternative Price #1: TL-1 alternative – Stone Tile Porfirica, Colour: Aglo Matte, Cut full size tile to size: 600 x 600mm, 10mm thickness	\$	\$
	<input type="checkbox"/> No change to the base bid price	

1.0 GENERAL

1.1. DEFINITIONS DECLARATION

- .1 CCDC 2-2008 Edition, Stipulated Price Contract as may be amended, forms the basis of Definitions between the Owner and Contractor.
- .2 These Definitions are bound to the CCDC 2 Definitions and CCDC 2 General Conditions.

1.2. SUPPLEMENTARY WORDS AND TERMS TO CCDC 2-2008

- .1 The following words and terms are additional to the CCDC 2 Definitions.
- .2 Addendum: A document that amends the Bid Documents during the Bidding Period and becomes part of the Contract Documents when a Contract is executed. (Plural: Addenda).
- .3 Agreement: The signed and sealed legal instrument binding parties in a Contract, describing in strict terms their mutual arrangement, roles and responsibilities, commencement, and completion responsibilities.
- .4 Alternative Price: The amount stipulated by a Bidder for an Alternative and stated as an addition, a deduction, or no change to the Bid Price.
- .5 Authorities: Those having jurisdiction under law over Work or Parts thereof.
- .6 Bid: To offer as a Bid stating for what price a Contractor will assume a Contract.
- .7 Bid Documents: A set of documents consisting of the Instructions to Bidders, Bid Form, Contract Documents, and other information issued for the benefit of Bidders to prepare and submit a Bid.
- .8 Bid Form: The specific and detailed form used to collect information about a Bid.
- .9 Bidding: The process of preparing and submitting a Bid.
- .10 Construction Documents: The Drawings and Project Manual. When combined with a Contract and Contract conditions, these documents form the Contract Documents.
- .11 Contingency Allowance: An additional monetary amount added to a Project cost estimate and designated to cover unpredictable or unforeseen items of Work. The amount is usually based on some percentage of the estimated cost and expended and adjusted by Change Order. It is not intended to cover additions to the scope of Work.
- .12 General Conditions: That part of the Contract Documents which sets forth many of the rights, responsibilities and relationships of the parties involved in a Contract.

- .13 Exposed: Visible at completion of Work, in useable areas as well as interior of closets, cabinets, drawers, storage and service rooms, stairwells and exterior surfaces.
- .14 Instructions To Bidders: Instructions contained in the Bid Documents to convey an Owner's expectations and criteria associated with submitting a Bid.
- .15 Section: A portion of a Project Specification covering one or more segments of the total Work or requirements. Sections are included in a Project manual as required to meet Project requirements.
- .16 Standard: A document describing a grade or a level of quality, which has been established by a recognized agency or organization, utilizing an internal voting process.
- .17 Separate Price: A separate price for work to be added to the base price if selected by the Owner. This price type is not a part of the base bid price.
- .18 Stipulated Price: An amount set forth in a Stipulated Price Contract as the total payment for the performance of the Work. Sometimes referred to as a stipulated sum or a lump sum stipulated price.
- .19 Tender: Refer to definition of Bid.
- .20 Unit Price: The amount payable for a single unit of Work as stated in a Schedule of Prices.
- .21 Install: To remove from site storage, move or transport to intended location, install in position, connect to utilities, repair site caused damage, and make ready for use.
- .22 Supply: To acquire or purchase, ship or transport to the site, unload, remove packaging to permit inspection for damage, re-package, replace damaged items, and safely store on-site.
- .23 Provide: To Supply and Install
- .24 Wherever words 'approved', 'selected', 'satisfactory', 'directed', 'permitted', 'inspected', 'instructed', 'required', 'submit', 'ordered', 'reviewed', 'reported to', or similar words or phrases are used in Contract Documents, it shall be understood, unless context provides otherwise, that words 'by Consultant' or 'to Consultants' follow.
- .25 Words 'by others' when used in Specifications or on Drawings shall not mean by someone other than Contractor. Only means by which something shown or specified shall be indicated as not being in Contract is by initials 'NIC' or words 'not in Contract', 'by Owner', or 'by Other Contractor'.

END OF SECTION

SECTION 00 72 13 – TERMS AND CONDITIONS

1.0 PROVISIONS

1.1. Proceedings Against the Board

- .1 The Proponent represents and warrants that the Proponent is not a party to any suits, actions, litigation proceedings, arbitration's, alternative dispute resolutions, investigations or claims by or against or otherwise involving the Board and the Proponent. The Board will reject the bid in the view of the current, pending or threatened litigation, arbitration, alternative dispute resolution or disputes involving the Board and Proponent. The Awarded Bidder may also be required, at the discretion of the Board, to sign a Certificate in a form satisfactory to the Board confirming that the Awarded Bidder is not associated with any company involved in litigation with the Board.

1.2. Standard of Behaviour

- .1 The Board will not knowingly purchase goods and/or services from Awarded Bidders who operate in contravention of local and international laws. Proponents submitting bids are in fact agreeing that they do not purchase or use products that are in contravention of local and international laws. If a product and/or service supplied to the Board is discovered to be in contravention, the Board reserves the right to rectify the issue with the Awarded Bidder that may include the cancellation of the contract.

1.3. Federal, Provincial, Regional and Municipal Laws

- .1 The Awarded Bidder must stay current and comply with, for the durations of the agreement, all current laws and bylaws.
- .2 No Smoking and Scents –Free
 - .1 The Province has legislated under the Smoke Free Ontario Act that smoking is not permitted on any Board owned properties. Furthermore, most Board properties are “scent free”. Smoking will not be permitted on-site. Offenders will be asked to leave the site, and infractions could result in corrective action and or fine.

1.4. Professional Conduct

- .1 All contractors must conduct themselves in a professional manner at all times when dealing with Board staff, with the public, and while working on site. Unprofessional conduct could result in immediate termination of the contract.

1.5. Sustainable Purchasing

The procurement needs of the Board represent a significant level of responsibility to demonstrate leadership and support for greener business practices. Integrating environmental performance and impact into supply chain decisions is a commitment to improvement of the environment and the quality of life.

Green procurement shall be viewed in the context of achieving value for money for the total life-cycle costs. It requires the inclusion of environmental impact considerations into the procurement process, including planning, acquisition, use and disposal. Value for money shall include the consideration of many environmental tangible and intangible factors when determining the total life-cycle costs and environmental impact.

1.6. Paramountcy Clause

.1 Proponents who have additional and/or supplementary agreements that require the Board's signature prior to providing the required products and/or services to the Board must submit that said draft agreement with their bid. No additional agreements will be accepted by the Board after the closing date Tender time of the Tender. In the event of any conflict between the provisions of the terms of the Awarded Bidder's additional and/or supplementary agreement(s) and the provisions of this Tender document, the terms of the Tender contract shall govern.

1.7. Freedom of Information

.1 To comply with the Freedom of Information and Protection of Privacy Act, all bids submitted to the Board become the property of the Board, and as such, are subject to the Freedom of Information and Protection of Privacy Act. Clearly identify any portion of the bid submission that could cause injury if disclosed.

1.8. Criminal Background Checks and Collection of Personal Information

.1 The Board must comply with Regulation 521 (Collection of Personal Information) to the Education Act with respect to criminal background checks and offence declarations.

.2 If required by the Board, the Awarded Bidder will provide the Board, or designate with a Criminal Background Check covering offences under the Criminal Code, the Controlled Drugs and Substances Act, and any other offences which would be revealed by a search of the automated Criminal Records Retrieval System.

- .3 An Offence Declaration in a Board-approved form for every individual or employee of the Awarded Bidder who may come into direct contact with Board staff and/or students on a regular basis at any Board site prior to the occurrence, and on or before September 1 each year thereafter is required. The Board will determine in its sole discretion whether an individual or employee of the Awarded Bidder come into direct contact with pupils on a regular basis.
- .4 Termination of contracts and indemnification by the Awarded Bidder will result from noncompliance.

1.9. Accessibility

- .1 Proponents shall comply with the provisions of the Accessibility for Ontarians with Disabilities Act, 2005, and the Regulations there under with regard to the provision of its goods or service to persons with disabilities. Proponents acknowledge that pursuant to the Accessibility for Ontarians with Disabilities Act, 2005, the Board must, in deciding to purchase goods or service through its procurement process, consider the accessibility for persons with disabilities to such goods or service.

2.0 COMMUNICATION

2.1. Verbal Communication

- .1 Neither the Board nor Board consultant will provide verbal direction or clarification during the tender process. As a result, verbal recollections will not be considered valid.

2.2. Request for Clarification

- .1 The Board reserves the right to seek clarification and supplementary information from Proponents after the Bid Submission Deadline. The response received by the Board from a Proponent shall, if accepted by the Board, form an integral part of that Proponent's proposal.

3.0 SPECIFICATIONS

3.1. Materials

- .1 Bid only on new materials in perfect condition. Demonstrators, seconds or defective materials are unacceptable. Any materials found not to be in a new

condition or as specified will be returned to the Awarded Bidder at the Awarded Bidder's expense.

- .2 Proponents, if requested by the Board, must furnish with their bid a materials safety data sheet (M.S.D.S.), for all products they are bidding on, where applicable. This is a requirement of the Occupational Health and Safety Act. Subsequently, should any business result from this Tender, the Board will not accept any additional charges or surcharges related to the supplying of M.S.D.S. for any item(s) on this Tender.
- .3 All electrical equipment and components must bear a C.S.A. or Electrical Safety Association (E.S.A.) label.
- .4 Bid prices must be for goods and/or services exactly as specified.

4.0 BID PREPARATION

The Board will not be liable for any costs incurred by the Proponent for the preparation of their bid.

4.1. Online Submission Forms

- .1 All forms are submitted online through the bidding system.
- .2 The bidder's signature has the authority to bind the Proponent.

4.2. Bid Price

- .1 Bid prices are to be shown as all applicable taxes extra.
- .2 Bid prices must be held firm until the project is completed to the satisfaction of the Board.
- .3 The bid price herein constitutes the total costs to the Board for all work involved in the respective items and that this cost also includes all insurance, transportation charges, use of all tools and equipment, supervision, bonds, overhead expense, warranty, all profits and all other work, services, conditions furnished in accordance with the requirements of the contract documents.
- .4 Bid prices must be in Canadian Funds.
- .5 Period for which bids are irrevocable after the tender submission deadline is: 60 days.

4.3. Bonding Requirements

- .1 Bid Amount

Bonding requirements are based on the total bid amount INCLUSIVE of ALL applicable taxes.

Bonding is not requested if the Board estimates that the project is less than \$200,000.00. The Board determines the Bonding requirements and specifies them on the Bid Sheet.

.2 Bid Bond and Agreement to Bond

Bid submissions that request Bonding are inclusive of all taxes and must be accompanied by a bid deposit in the form of a digital Bid Bond in an electronically verifiable and enforceable (e-Bond) format in the amount(s) not less than 10% of the total Contract Value made payable to the Waterloo Region District School Board (the 'Board') as surety that, if the Bid is accepted, a Contract will be entered into for the proper performance of the work. For more information, contact your surety company or visit the Surety Association of Canada website.

Bidders shall upload their Bid Bond to the Bidding System, in the bid submission file labeled "Bid Bond". All instruction and details for accessing authentication shall be included with the digital Bond uploaded in the Bidding System.

Bids that do not contain the bid deposit(s) in the required amount as specified in this paragraph will be declared non-compliant and will be rejected. A scanned PDF copy of bonds or original certified cheque, bank draft, money order, etc. are not acceptable as Bid deposit and will result in your Bid being rejected.

The bid deposit of the Bidder whose submission is accepted shall be forfeited by the Bidder should the Bidder fail to execute a Contract or provide the necessary documents as required within this Bid Solicitation document (including signed agreement, satisfactory security, insurance certificate, Workplace Safety and Insurance Board letter of clearance) within the time stipulated as a written notice from the Board.

For bid amounts where Bonding is not requested, the Awarded Bidder agrees to pay to the Board the difference in costs between the bid submitted and the final contract should the Awarded Bidder fail to either execute or deliver the contract documents in accordance with the Bid Solicitation within ten (10) working days of written notification of the award of the contract.

.3 Performance Securities

For bid amounts where bonding is required, inclusive of all taxes, upon award the successful Bidder shall provide a digital Bid Performance and Labour and Materials Bond in an electronically verifiable and enforceable (e-Bond) format in the amount(s) of not less than 50% Performance Bond and a 50% Labour and Materials Bond of the total Contract Value made payable to the Waterloo Region

District School Board (the 'Board') as surety that, if the Bid is accepted, a Contract will be entered into for the proper performance of the work. For more information, contact your surety company or visit the Surety Association of Canada website.

If the successful Bidder fails to provide a performance bond when requested, the Board may declare the bid deposit forfeited and the Bidder will be held responsible for any increased costs or damages incurred by the Board. Any Bidder who fails to provide all required documents within the timelines provided, or otherwise fails to enter into an agreement with the Board upon notice of being the successful Bidder may be subject to future bidding constraints by the Board.

Performance surety shall guarantee all conditions as set out in the contract, including proper execution of the work and for all matters for which the successful Bidder is responsible for throughout the two (2) year period of maintenance and warranty.

Any costs associated with performance surety are the responsibility and cost of the Bidder.

Bonds must be submitted through the Bidding System within ten (10) days of receiving the Intent to Award.

4.4. INSURANCE

.1 Proof of WSIB Coverage (Onsite work only)

If the Proponent does not provide a policy endorsement for Employer's Liability and Voluntary Compensation, the Proponent shall submit a valid certificate of WSIB coverage to the Board, with the tender submission and any subsequent policy renewal, referencing this Agreement. The Proponent shall ensure that each Subcontractor complies with the WSIB requirements set out in this Article by obtaining similar types of coverage if the Subcontractor does not provide a policy endorsement for Employer's Liability and Voluntary Compensation.

.2 Insurance (Onsite Construction work only)

The proponent is to reference CCDC2-2008 GC 11.1 Insurance and ensure that this section is adhered to.

.3 General & Vehicle

General and vehicle liability insurance covering incidents of property damage or bodily injury (including death) for owned and non-owned vehicle accidents

occurring during the work in this Tender, or actions of the employees of the Awarded Bidder while acting within the scope of their duties as required in this Tender shall be maintained. Verification of current "Good Standing" may be requested.

The inclusive per incident minimum amount of coverage is: Two Million Dollars (\$2,000,000).

5.0 BID EVALUATION

Preference will be given to the lowest compliant bid.

The "lowest bid price" shall be used to determine the lowest compliant bid. Alternate prices, separate prices and any substitutions that may affect the contract price shall not be considered in determining the "lowest bid price".

The Proponent will not be awarded the tender if the Site Supervisor and/or Project Manager identified by the Proponent are not deemed suitable by the Board.

If the Board has a sense that the Proponent with "lowest bid price" has capacity issues, then the Board will meet with the Proponent after the tender closing date and prior to the Board awarding the Tender.

At the meeting the Proponent will present the following in written form:

1. The Proponent's capacity resource plan documents which illustrates how the Proponent determines capacity.
2. The level of capacity the Proponent and its resources would be with the award of the Tender.
3. An evaluation of recent projects that the Proponent has completed, where the Proponent was at equal or greater capacity as it relates to the capacity resources available.

In order for the Proponent's bid to be considered the lowest compliant bid the Proponent will to the Board's satisfaction have presented in written from the information requested.

6.0 BID RESULTS NOTIFICATION

The Board will forward the results notification to <https://wrdsb.bidsandtenders.ca> listing the Awarded Bidder and Bid Price.

7.0 AWARD NOTIFICATION

No shipment is to be made or work to commence until a purchase order, contract, or letter of intent is issued by Procurement Services to the Awarded Bidder.

Construction Projects

For construction projects above \$200,000 the Awarded Bidder may be required to execute a "Canadian Standard Form of Construction Contract to a Stipulated Sum" (revised 2008) CCDC 2, 2008 including amendments thereto as set out in this Tender.

The Awarded Bidder shall execute the said formal contract as called for, within seven (7) working days after notification of acceptance of their Tender or forfeit the amount of Bid Bond enclosed in the Tender.

8.0 POST AWARD

8.1. Bonding (Construction)

Upon receiving the Intent to Award letter, the Bidder is solely responsible for submitting Bonding documents through the Bidding System. Payments to the Awarded Bidder will not be processed without bonding being submitted. Failure to submit bonding within seven (7) working days may result in the cancellation of the contract.

8.2. Purchase Order

For Payment purposes, a Purchase Order shall be generated and issued to the Awarded Bidder(s). The Purchase Order number must appear on all invoices in order to ensure prompt payment.

8.3. Changes

The Board may order changes in the material or work, in writing, with the contract sum being adjusted accordingly. All changes for additional material or work must be agreed upon and submitted in writing to the Board.

9.0 SUBCONTRACTING

9.1. Subcontracting

Subcontracting, beyond the original list of subcontractors submitted with bid submission, of any portion of the work outlined in these specifications will not be permitted without prior written consent of the Board.

If approval is granted, any work undertaken by subcontractors shall be as set forth in this Tender document and the use of subcontractors shall in no way relieve the Awarded Bidder of their responsibilities.

The Board reserves the right to reject a proposed subcontractor for any reasonable cause.

9.2. Assignment

Any business resulting from this Tender call shall not be assigned to any other company (or individual) without prior written approval of the Board.

10.0 FORCE MAJEURE

If Delays in a failure of performance by either party under the Contract shall not constitute default hereunder or give rise to any claim for damages if and to the extent caused by occurrences beyond the control of the party affected, including but not limited to decrees of Government, acts of God, fires, floods, explosions, pandemics, riots, war, rebellion, sabotage and atomic or nuclear incidents, lawful acts of public authorities, or delays caused by common carriers, which cannot reasonably be foreseen or provided against. However, lack of finances, strikes, or other concerted acts by workers, delay or failure arising out to the nature of the work to be done, or from the normal actions of the elements or from any normal difficulties which may be encountered in the performance of the Work, having regard to the nature thereof, shall in no event be deemed to be a cause beyond a party's control. If in the reasonable opinion of either party to this Contract that performance of the Contract is made impossible by force majeure, then either party shall notify the other in writing and the Board shall either terminate the Contract forthwith without any future payments being made or authorize the Vendor to continue performance of the Contract with such adjustments as may be required by the existence of the force majeure and agreed upon by both parties.

11.0 TERMINATION

11.1. Sufficient Cause

The Board reserves the right to terminate any contract Tender purchase order resulting from this Tender call for sufficient cause, such as: non-performance, late

deliveries, inferior quality, pricing problems, customer service, etc. Should such action be necessary, the Board would provide written notice to the Awarded Bidder.

11.2. Funding Out

Should the Board fail to appropriate funds to enable payments including multi-year agreements, the Board may cancel the contract without termination charges, provided the Awarded Bidder receive thirty (30) days written notice of such termination from the Board.

12.0 RESULT DISPUTE PROCESS

Subsequent to a debriefing a Proponent may dispute the decision of the Board. The process outlined below is to be followed:

The Proponent is to file in writing their protest with the Manager of Procurement by certified mail, within force 15 business days of the Debriefing. The Protest Notice shall include:

- (i) The name and address of the Proponent.
- (ii) Identification of the RFX.
- (iii) Detailed and factual statement of the grounds for protest.
- (iv) Supporting documentation.
- (v) Desired relief, action ruling.

The Manager of Procurement will respond to the Proponent, by certified mail, within 20 business days of receiving the written notice.

If a resolution cannot be met, the Proponent must contact the Superintendent of Business and Financial Services by certified mail, within 10 business days of receiving the first response from the Manager of Procurement. The decision by the Superintendent of Business and Financial Services will be deemed final and the Proponent will receive written notice within 20 business days.

13.0 RIGHTS OF THE BOARD

In addition to any other express rights or any other rights which may be implied in the circumstances, the Board reserves the right to:

- (i) Reject any bid received from a Proponent which is party to any past or existing suits, actions, and litigation proceedings, arbitration's, alternative dispute resolutions, investigations, vendor performance evaluations that are below expectations or claims by or against or otherwise involving the Board and the Proponent. Note: the Awarded Bidder(s) may also be required, at the discretion of the Board, to sign a Certificate in a form satisfactory to the Board confirming that the Awarded Bidder(s) is not associated with any company involved in litigation with the Board.
- (ii) make public the names of any or all Proponents;
- (iii) request written clarification or the submission of supplementary written information from any Proponent;
- (iv) waive formalities and accept Bids which substantially comply with the requirements of this tender;
- (v) verify with any Proponent or with a third party any information set out in a Bid;
- (vi) disqualify any Proponent whose Bid contains misrepresentations or any other inaccurate or misleading information;
- (vii) disqualify any Proponent or the Bid of any Proponent who has engaged in conduct prohibited by this tender;
- (viii) make changes, including substantial changes, to this tender provided that those changes are issued by way of addenda in the manner set out in this tender;
- (ix) accept or reject a Bid if only one Bid is submitted;
- (x) accept or reject the lowest or any bid not necessarily accepted by the Board;
- (xi) select any Proponent other than the Proponent whose Bid reflects the highest compliant score to the Board;
- (xii) cancel this TENDER process at any stage;
- (xiii) cancel this TENDER process at any stage and issue a new TENDER for the same or similar services with a minimum substantial change in scope of 10%;
- (xiv) accept any Bid in whole or in part;
- (xv) discuss with any Proponent different or additional terms to those contemplated in this tender or in any Proponent's Bid;

(xvi) reject any or all Bids in its absolute discretion;

(xvii) negotiate with the leading Proponent prior to award;

(xviii) evaluate and accept Proponent's alternatives whereby possible efficiencies may prove to be advantageous to the Board;

(xix) to all Bids, responses, inquiries, or other related correspondence in reference to this tender, and all reports, charts, and other documentation submitted by Proponents shall become the property of the Waterloo Region District School Board when received; and the Board shall not be liable for any expenses, costs associated with the preparation and submittal of any proposal(s), or for any travel and or per diem costs that are incurred including any or all product samples that may be requested during the evaluation stage of the proposal, losses or any direct or indirect damages incurred or suffered by any Proponent or any third party resulting from the Board exercising any of its rights under this TENDER or exercising any rights, which may be implied in the circumstances.

By submitting its Bid, the Proponent authorizes the collection by the Board of the information set out under (v), (vi) and (vii) in the manner contemplated in those subparagraphs.

13.1. Volume and Exclusivity

The Board makes no guarantee of the value or volume of work to be assigned to the Awarded Bidder. Any agreement executed with the Awarded Bidder may not be an exclusive contract for the provision of the described goods/services.

END OF SECTION

**SUPPLEMENTARY CONDITIONS & AMENDMENTS TO STANDARD CONSTRUCTION
DOCUMENT CCDC2 -2008 STIPULATED PRICE SUBCONTRACT**

(the “Supplementary Conditions”)

**AGREEMENT, DEFINITIONS, AND
GENERAL CONDITIONS**

The Standard Construction Document CCDC 2 2008 for a Stipulated Price Contract, English version, consisting of the Agreement Between *Owner* and Contractor, Definitions and General Conditions of the Stipulated Price Contract, Parts 1 to 12 inclusive, governing same, together with the changes with the new *Construction Act* is hereby made part of these *Contract Documents*, with the following amendments, additions and modifications:

AGREEMENT BETWEEN OWNER AND CONTRACTOR

SC1 ARTICLE A-3 – CONTRACT DOCUMENTS

SC1.1	3.1	<p><u>Add</u> the following documents to the list of <i>Contract Documents</i> in Article A-3.1:</p> <ul style="list-style-type: none"> • Waterloo Region District School Board’s Supplementary Conditions & Amendments to Standard Construction Document CCDC2 -2008 Stipulated Price Subcontract, November 2020 Version, including any Special Supplementary Conditions listed in Appendix 2 thereto • <i>Drawings</i> • <i>Specifications</i> • Performance Bond (Form 32 -Performance Bond under Section 85.1 of the <i>Act</i>) • Labour and Material Payment Bond (Form 31 – Labour and Material Payment Bond under Section 85.1 of the <i>Act</i>) [NTD: Remove documents and references if not applicable.]
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SC2 ARTICLE A-5 – PAYMENT

SC2.1	5.1	<p>In Article A-5.1 after the word “Subject to” <u>insert</u> the words “GC 13.2 and” -and- <u>delete</u> the words “and, where such legislation or regulations do not exist or apply, subject to a holdback of ten + two percent (10+2%)” and <u>replace</u> them with “and the <i>Owner’s</i> right to issue <i>Notices of Non-Payment</i>.”</p>
SC2.2	5.1.1	<p><u>Delete</u> the words “amount certified by the <i>Consultant</i> together” in subparagraph 5.1.1 and <u>replace</u> them with “allowable amount set out in a <i>Proper Invoice</i>”.</p>

SC2.3	5.1.2	<p><u>Delete</u> subparagraph 5.1.2 in its entirety and <u>replace</u> it with the following:</p> <p>“.2 upon <i>Substantial Performance of the Work</i>, as certified by the <i>Consultant</i>, and on the 61st day after the publication of the certificate of <i>Substantial Performance of the Work</i> in accordance with the <i>Act</i>, there being no claims for lien registered against the title to the <i>Place of the Work</i>, pay the <i>Contractor</i> the unpaid balance of the holdback together with such <i>Value Added Taxes</i> as may be applicable to such payment, less any amount stated in the <i>Owner’s Notice of Non-Payment</i>,”</p>
SC2.4	5.1.3	<p><u>Delete</u> subparagraph 5.1.3 in its entirety and <u>replace</u> it with the following:</p> <p>“.3 upon receipt of the final certificate for payment from the <i>Consultant</i>, and on the 61st day after the date on which the <i>Contractor</i> completes the <i>Work</i>, there being no claims for lien registered against the title to the <i>Place of the Work</i>, pay the <i>Contractor</i> the unpaid balance of the <i>Contract Price</i> together with such <i>Value Added Taxes</i> as may be applicable to such payment , and”</p>
SC2.5	5.3.1	<p><u>Delete</u> paragraph 5.3.1 in its entirety and <u>replace</u> it with the following:</p> <p>“.1 Should either party fail to make payments as they become due under the terms of the <i>Contract</i> or in an award by arbitration or court, interest shall also become due and payable on such unpaid amounts at the prejudgment interest rate prescribed by the <i>Courts of Justice Act</i> (Ontario), as it may change from time to time.”</p>

SC3 *NEW* ARTICLE A-9 – CONFLICT OF INTEREST

SC3.1	Article A-9	<p><u>Add</u> new ARTICLE A-9 CONFLICT OF INTEREST as follows:</p> <p>“ARTICLE A-9 CONFLICT OF INTEREST</p> <p>9.1 The <i>Contractor, Subcontractors and Suppliers</i> and any of their respective advisors, partners, directors, officers, employees, agents, and volunteers shall not engage in any activity or provide any services where such activity or the provision of such services creates a conflict of interest (actually or potentially, in the sole opinion of the <i>Owner</i>) with the provision of the <i>Work</i> pursuant to the <i>Contract</i>. The <i>Contractor</i> acknowledges and agrees that a conflict of interest, as described in this Article A-9, includes, but is not limited to, the use of <i>Confidential Information</i> where the <i>Owner</i> has not specifically authorized such use.</p> <p>9.2 The <i>Contractor</i> shall disclose to the <i>Owner</i>, in writing, without delay, any actual or potential situation that may be reasonably interpreted as either a conflict of interest or a potential conflict of interest, including the retention of any <i>Subcontractor</i> or <i>Supplier</i> that is directly or indirectly affiliated with or related to the <i>Contractor</i>.</p> <p>9.3 The <i>Contractor</i> covenants and agrees that it will not hire or retain the services of any employee or previous employee of the <i>Owner</i> where to do so constitutes a breach by such employee or previous employee of the <i>Owner’s</i> conflict of interest policy, as it may be amended from time to time, until after completion of the <i>Work</i> under the <i>Contract</i>.</p> <p>9.4 It is of the essence of the <i>Contract</i> that the <i>Owner</i> shall not have direct or indirect liability to any <i>Subcontractor</i> or <i>Supplier</i>, and that the <i>Owner</i> relies on the maintenance of an arm's-length relationship between the <i>Contractor</i> and its <i>Subcontractors and Suppliers</i>. Consistent with this fundamental term of the <i>Contract</i>, the <i>Contractor</i> will not enter into any agreement or understanding with any <i>Subcontractor</i> or <i>Supplier</i>, whether as part of any contract or any written or oral collateral agreement, pursuant to which the parties thereto agree to cooperate in the presentation of a claim for payment against the <i>Owner</i>, directly or through the <i>Contractor</i>, where such claim is, in whole or in part, in respect of a disputed claim by the <i>Subcontractor</i> or <i>Supplier</i> against the <i>Contractor</i>, where the payment to the <i>Subcontractor</i> or <i>Supplier</i> by the <i>Contractor</i> is agreed to be conditional or contingent on the ability to recover those amounts or a portion thereof from the <i>Owner</i>, failing which the <i>Contractor</i> shall be saved harmless from all or a portion of those claims. The <i>Contractor</i> acknowledges that any such agreement would undermine the required arm's-length relationship and constitute a conflict of interest. For greater certainty, the <i>Contractor</i> shall only be entitled to advance</p>
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		<p>claims against the <i>Owner</i> for amounts pertaining to <i>Subcontractor</i> or <i>Supplier</i> claims where the <i>Contractor</i> has actually paid or unconditionally acknowledged liability for those claims or where those claims are the subject of litigation or binding arbitration between the <i>Subcontractor</i> or <i>Supplier</i> and the <i>Contractor</i> has been found liable for those claims.</p> <p>9.5 Notwithstanding 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, a breach of this Article A-9 by the <i>Contractor</i>, any of the <i>Subcontractors</i>, or any of their respective advisors, partners, directors, officers, employees, agents, and volunteers shall entitle the <i>Owner</i> to terminate the <i>Contract</i>, in addition to any other rights and remedies that the <i>Owner</i> has in the <i>Contract</i>, in law, or in equity."</p>
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SC4 *NEW* ARTICLE A-10 TIME OF THE ESSENCE

SC4.1	Article A-10	<p><u>Add</u> the following new Article A-10 as follows:</p> <p>"ARTICLE A-10 TIME OF THE ESSENCE</p> <p>10.1 It is agreed that one of the reasons the <i>Contractor</i> was selected by the <i>Owner</i> for this <i>Contract</i> is the <i>Contractor's</i> representation and covenant that it will attain <i>Substantial Performance of the Work</i> within the <i>Contract Time</i> stated in Article A-1 of this <i>Contract</i>.</p> <p>10.2 The <i>Contractor</i> acknowledges and agrees that it is responsible to marshal its resources and those of its <i>Subcontractors and Suppliers</i> in a manner which will permit timely attainment of the <i>Substantial Performance of the Work</i>. The <i>Contractor</i> agrees that time is of the essence of this <i>Contract</i>."</p>
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SC5 DEFINITIONS

SC5.1	Consultant	<p><u>Amend</u> the definition of "Consultant" by <u>adding</u> the following to the end of the definition:</p> <p>"For the purposes of the <i>Contract</i>, the terms "<i>Consultant</i>", "<i>Architect</i>" and "<i>Engineer</i>" shall be considered synonymous."</p>
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SC5.2	Act	<p><u>Add</u> the following definition:</p> <p>“27. Act</p> <p><i>Act</i> means the <i>Construction Act</i>, R.S.O. 1990, c. C.30, as amended, including all regulations passed under it that are enforceable as of the date of execution of this <i>Contract</i>. For certainty, the first procurement process for the <i>Project</i> (i.e. the “improvement” as that term is defined in the <i>Act</i>) was commenced on or after October 1, 2019.”</p>
SC5.3	Adjudication	<p><u>Add</u> the following definition:</p> <p>“28. Adjudication</p> <p><i>Adjudication</i> means construction dispute interim adjudication as defined under the <i>Act</i>.”</p>
SC5.4	Confidential Information	<p><u>Add</u> the following definition:</p> <p>“29. Confidential Information</p> <p><i>Confidential Information</i> means all the information or material of the <i>Owner</i> that is of a proprietary or confidential nature, whether it is identified as proprietary or confidential or not, including but not limited to information and material of every kind and description (such as drawings and move-lists) which is communicated to or comes into the possession or control of the <i>Contractor</i> at any time, but <i>Confidential Information</i> shall not include information that:</p> <ol style="list-style-type: none"> .1 is or becomes generally available to the public without fault or breach on the part of the <i>Contractor</i>, including without limitation breach of any duty of confidentiality owed by the <i>Contractor</i> to the <i>Owner</i> or to any third party, but only after that information becomes generally available to the public; .2 the <i>Contractor</i> can demonstrate to have been rightfully obtained by the <i>Contractor</i> from a third party who had the right to transfer or disclose it to the <i>Contractor</i> free of any obligation of confidence; .3 the <i>Contractor</i> can demonstrate to have been rightfully known to or in the possession of the <i>Contractor</i> at the time of disclosure, free of any obligation of confidence; or .4 is independently developed by the <i>Contractor</i> without use of any <i>Confidential Information</i>.”
SC5.5	Construction Schedule	<p><u>Add</u> the following definition:</p> <p>“30. Construction Schedule or construction schedule</p>

		<i>Construction Schedule</i> means the schedule for the performance of the <i>Work</i> provided by the <i>Contractor</i> pursuant to GC 3.5, including any amendments to the <i>Construction Schedule</i> made pursuant to the <i>Contract Documents</i> .”
SC5.6	Construction Schedule Update	<p><u>Add</u> the following definition:</p> <p>“31. Construction Schedule Update</p> <p><i>Construction Schedule Update</i> means an update to the <i>Construction Schedule</i> by the <i>Contractor</i> using Microsoft Project (or other approved scheduling software) that accurately depicts the progress of the <i>Work</i> relative to the critical path established in the <i>Construction Schedule</i> approved in GC 3.5.1 (or any approved successor <i>Construction Schedule</i>), aligns with the currently approved date for <i>Substantial Performance of the Work</i>, shows up-to-date projected major activity sequences and durations, and shows any changes or delays in anticipated completion dates of major activities in the <i>Work</i> relative to the last <i>Construction Schedule Update</i>, and includes the following minimum deliverables:</p> <p style="padding-left: 40px;">(a) a record version of the updated <i>Construction Schedule</i> in .pdf format;</p> <p style="padding-left: 40px;">(b) an editable copy of the updated <i>Construction Schedule</i> in native format (e.g. .mpp format for Microsoft Project).”</p>
SC5.7	Direct Costs	<p><u>Add</u> the following definition:</p> <p>“32. Direct Costs</p> <p><i>Direct Costs</i> are the reasonable costs of performing the contract or subcontract including costs related to the additional supply of services or materials (including equipment rentals), insurance and surety bond premiums, and costs resulting from seasonal conditions, that would not have been incurred, but do not include indirect damages suffered, such as loss of profit, productivity or opportunity, or any head office overhead costs.”</p>
SC5.8	EFT	<p><u>Add</u> the following definition:</p> <p>“33. EFT</p> <p><i>EFT</i> has the definition given to it under GC 5.3.2.”</p>
SC5.9	Force Majeure	<u>Add</u> the following definition:

		<p>“34. Force Majeure</p> <p><i>Force Majeure</i> means any cause, beyond either parties’ control, other than bankruptcy or insolvency, which prevents the performance by a party, or both, of any of their respective obligations under the <i>Contract</i> and the event of <i>Force Majeure</i> did not arise from a party’s default and could not be avoided or mitigated by the exercise of reasonable effort or foresight. <i>Force Majeure</i> includes: <i>Labour Disputes</i>; fire; unusual delay by common carriers or unavoidable casualties; delays in obtaining permits or licenses; civil disturbance; emergency acts, orders, legislation, regulations or directives of any government or other public authority; acts of a public enemy; war; riot; sabotage; blockage embargo; lightning; earthquake; adverse weather conditions but only if substantially beyond the weather norms of the <i>Place of the Work</i>; acts of God; or declared epidemic or pandemic outbreak or other public health emergency (e.g. SARS, COVID-19).”</p>
SC5.10	Install	<p><u>Add</u> the following definition:</p> <p>“35. Install</p> <p><i>Install</i> means install and connect. <i>Install</i> has this meaning whether or not the first letter is capitalized.”</p>
SC5.11	Labour Dispute	<p><u>Add</u> the following definition:</p> <p>“36. Labour Dispute</p> <p><i>Labour Dispute</i> means any lawful or unlawful labour problems, work stoppage, labour disruption, strike, job action, slow down, lock-outs, picketing, refusal to work or continue to work, refusal to supply materials, cessation or work or other labour controversy which does, or might, affect the <i>Work</i>.”</p>
SC5.12	Notice of Non-Payment	<p><u>Add</u> the following definition:</p> <p>“37. Notice of Non-Payment</p> <p><i>Notice of Non-Payment</i> means a notice of non-payment of holdback (Form 6) or a notice of non-payment (Form 1.1) under the <i>Act</i>, as applicable to the circumstances.”</p>
SC5.13	OHSA	<p><u>Add</u> the following definition:</p> <p>“38. OHSA</p> <p><i>OHSA</i> means the <i>Occupational Health and Safety Act</i>, R.S.O. 1990, c. O.1, as amended, including all regulations thereto.”</p>

SC5.14	Overhead	<p><u>Add</u> the following definition:</p> <p>“39. Overhead</p> <p><i>Overhead</i> means all site and head office operations and facilities, all site and head office administration and supervision; all duties and taxes for permits and licenses required by the authorities having jurisdiction at the <i>Place of the Work</i>; all requirements of Division 1, including but not limited to submittals, warranty, quality control, calculations, testing and inspections; meals and accommodations; and, tools, expendables and clean-up costs.”</p>
SC5.15	Payment Period	<p><u>Add</u> the following definition:</p> <p>“40. Payment Period</p> <p><i>Payment Period</i> has the definition given to it under GC 5.2.1.”</p>
SC5.16	Pre-Invoice Submission Meeting	<p><u>Add</u> the following definition:</p> <p>“41. Pre-Invoice Submission Meeting</p> <p><i>Pre-Invoice Submission Meeting</i> has the definition given to it under GC 5.2.1.”</p>
SC5.17	Proper Invoice	<p><u>Add</u> the following definition:</p> <p>“42. Proper Invoice</p> <p><i>Proper Invoice</i> means a “proper invoice” as that term is defined in Section 6.1 of the <i>Act</i>, including the minimum requirements set out in Appendix “1” of the Supplementary Conditions.”</p>
SC5.18	Proper Invoice Submission Date	<p><u>Add</u> the following definition:</p> <p>“43. Proper Invoice Submission Date</p> <p><i>Proper Invoice Submission Date</i> has the definition given to it under GC 5.2.2.1.”</p>
SC5.19	Request for Information (RFI)	<p><u>Add</u> the following definition:</p> <p>“44. Request for Information (RFI)</p> <p><i>Request for Information</i> or <i>RFI</i> means written documentation sent by the <i>Contractor</i> to the <i>Owner</i> or to the <i>Owner’s</i> representative or the <i>Consultant</i> requesting written clarification(s) and/or interpretation(s) of the <i>Drawings</i> and/or <i>Specifications</i>, <i>Contract</i> requirements and/or other pertinent information required to complete the <i>Work</i> of the <i>Contract</i> without applying for a change or changes to the <i>Work</i>.”</p>

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GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT

Where a General Condition or paragraph of the General Conditions of the *Contract* is deleted by these amendments, the numbering of the remaining General Conditions or paragraphs shall remain unchanged, unless stated otherwise herein, and the numbering of the deleted item will be retained, unused.

PART 1 GENERAL PROVISIONS

SC6 GC 1.1 CONTRACT DOCUMENTS

SC6.1	1.1.6	<p><u>Add</u> the following to the end of paragraph 1.1.6:</p> <p>“The <i>Specifications</i> are divided into divisions and sections for convenience but shall be read as a whole and neither such division nor anything else contained in the <i>Contract Documents</i> will be construed to place responsibility on the <i>Owner</i> or the <i>Consultant</i> to settle disputes among the <i>Subcontractors</i> and <i>Suppliers</i> with respect to such divisions. The <i>Drawings</i> are, in part, diagrammatic and are intended to convey the scope of the <i>Work</i> and indicate general and appropriate locations, arrangements and sizes of fixtures, equipment and outlets. The <i>Contractor</i> shall obtain more accurate information about the locations, arrangements and sizes from study and coordination of the <i>Drawings</i>, including <i>Shop Drawings</i> and shall become familiar with conditions and spaces affecting those matters before proceedings with the <i>Work</i>. Where site conditions require reasonable minor changes where the change requires only the additional labour of one half hour or less, the <i>Contractor</i> shall make such changes at no additional cost to the <i>Owner</i>. Similarly, where known conditions or existing conditions interfere with new installation and require relocation, the <i>Contractor</i> shall include such relocation in the <i>Work</i>. The <i>Contractor</i> shall arrange and install fixtures and equipment in such a way as to conserve as much headroom and space as possible. The schedules are those portions of the <i>Contact Documents</i>, wherever located and whenever issued, which compile information of similar content and may consist of drawings, tables and/or lists.”</p>
SC6.2	1.1.7.1	<p><u>Delete</u> paragraph 1.1.7.1 in its entirety and <u>replace</u> it with the following:</p> <p>“.1 the order of priority of documents, from highest to lowest, shall be:</p> <ul style="list-style-type: none"> - the Supplementary Conditions; - the Agreement between the <i>Owner</i> and the <i>Contractor</i>, - the Definitions

		<ul style="list-style-type: none"> - the General Conditions, - Division 1 of the <i>Specifications</i>, - technical <i>Specifications</i>, - material and finishing schedules - the <i>Drawings</i>.”
SC6.3	1.1.7.5 to 1.1.7.8	<p><u>Add</u> new subparagraphs 1.1.7.5, 1.1.7.6, 1.1.7.7 and 1.1.7.8 as follows:</p> <p>“1.1.7.5 Noted materials and annotations on the <i>Drawings</i> shall govern over the graphic representation of the <i>Drawings</i>.</p> <p>1.1.7.6 Finishes in the room finish schedules shall govern over those shown on the <i>Drawings</i>.</p> <p>1.1.7.7 Architectural drawings shall have precedence over structural, plumbing, mechanical, electrical and landscape drawings insofar as outlining, determining and interpreting conflicts over the required design intent of all architectural layouts and architectural elements of construction, it being understood that the integrity and installation of the systems designed by the <i>Consultant</i> or its sub-<i>Consultants</i> are to remain with each of the applicable drawing disciplines.</p> <p>1.1.7.8 Should reference standards contained in the <i>Specifications</i> conflict with the <i>Specifications</i>, the <i>Specifications</i> shall govern. Should reference standards and <i>Specifications</i> conflict with each other or if certain requirements of the <i>Specifications</i> conflict with other requirements of the <i>Specifications</i>, the more stringent requirements shall govern.”</p>
SC6.4	1.1.8	<p><u>Delete</u> paragraph 1.1.8 in its entirety and <u>replace</u> it with the following:</p> <p>“1.1.8 The <i>Consultant</i>, on behalf of the <i>Owner</i> shall provide the <i>Contractor</i> without charge, PDF copies of the <i>Contract Documents</i>.</p>

SC7 GC 1.3 RIGHTS AND REMEDIES

SC7.1	1.3.2	In paragraph 1.3.2 <u>delete</u> the word “No” from the beginning of the paragraph and <u>replace</u> it with the words: “Except with respect to the requirements set out in paragraphs 2.2.13, 6.4.1, 6.5.4, 6.6.1 and 8.2.2, no...”
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SC8 *NEW* GC 1.5 EXAMINATION OF DOCUMENTS AND SITE

SC8.1	1.5	<u>Add</u> new GC 1.5 – EXAMINATION OF DOCUMENTS AND SITE as follows: “GC 1.5 EXAMINATION OF DOCUMENTS AND SITE 1.5.1 The <i>Contractor</i> declares and represents that in tendering for the <i>Work</i> , and in entering into a <i>Contract</i> with the <i>Owner</i> for the performance of the <i>Work</i> , it has investigated for itself the character of the <i>Work</i> to be done, based on information generally available from a visit to the <i>Place of the Work</i> and to the standard set out under GC 3.14.1 The <i>Contractor</i> has assumed and does hereby assume all risk of known conditions now existing or arising in the course of the <i>Work</i> which might or could make the <i>Work</i> , or any items thereof more expensive in character, or more onerous to fulfil, than was contemplated or known when the tender was made or the <i>Contract</i> signed. 1.5.2 The <i>Contractor</i> also declares that in tendering for the <i>Work</i> and in entering into this <i>Contract</i> , the <i>Contractor</i> did not and does not rely upon information furnished by the <i>Owner</i> or any of its agents or servants respecting the nature or confirmation of the ground at the site of the <i>Work</i> , or the location, character, quality or quantity of the materials to be removed or to be employed in the construction of <i>Work</i> , or the character of the construction machinery and equipment or facilities needed to perform the <i>Work</i> , or the general and local performance of the work under the <i>Contract</i> and expressly waives and releases the <i>Owner</i> from all claims with respect to the said information with respect to the <i>Work</i> . 1.5.3 <i>Contractor</i> further represents, warrants and acknowledges that it considered and took into account in the <i>Contract Price</i> all reasonably known impacts and restrictions arising from the COVID-19 pandemic, including without limitation corresponding legislative changes that may impact performance of the <i>Project</i> , various weather conditions that may affect the <i>Work</i> , the availability of supplies and labour or other conditions or risks that the <i>Contractor</i>
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		knew about or reasonably ought to have known about prior to the date of the <i>Contract</i> .”
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PART 2 ADMINISTRATION OF THE CONTRACT

sc9 GC 2.2ROLE OF THE CONSULTANT

SC9.1	2.2.4	<u>Delete</u> paragraph 2.2.4 in its entirety.
SC9.2	2.2.5	<u>Delete</u> paragraph 2.2.5 and <u>replace</u> it with the following: “2.2.5 Upon receipt of an application for payment that satisfies the requirement of a <i>Proper Invoice</i> , based on the <i>Consultant's</i> observations and evaluation of the <i>Contractor's</i> application for payment, the <i>Consultant</i> will determine the amounts owing to the <i>Contractor</i> under the <i>Contract</i> and will issue certificates for payment as provided in Article A-5 - PAYMENT, GC 5.3 PROGRESS PAYMENT, GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK, and GC 5.7 - FINAL PAYMENT. If the <i>Consultant</i> determines that the amount payable to the <i>Contractor</i> differs from the amount stated in a <i>Proper Invoice</i> , the <i>Consultant</i> shall notify the <i>Owner</i> as provided in GC 5.3.1.2 and prepare a draft of the applicable <i>Notice of Non-Payment</i> for the amount in dispute.”
SC9.3	2.2.7	<u>Delete</u> the words “Except with respect to GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER”.
SC9.4	2.2.13	At paragraph 2.2.13, <u>insert</u> the following at end of that paragraph: “If, in the opinion of the <i>Contractor</i> , the <i>Supplemental Instruction</i> involves an adjustment in the <i>Contract Price</i> or in the <i>Contract Time</i> , it shall, within ten (10) <i>Working Days</i> of receipt of a <i>Supplemental Instruction</i> , provide the <i>Consultant</i> with a notice in writing to that effect. Failure to provide written notification within the time stipulated in this paragraph 2.2.13 shall be deemed an acceptance of the <i>Supplemental Instruction</i> by the <i>Contractor</i> , without any adjustment in the <i>Contract Price</i> or <i>Contract Time</i> .”

SC10 GC 2.3 REVIEW AND INSPECTION OF THE WORK

SC10.1	2.3.2	<u>Amend</u> paragraph 2.3.2 by <u>adding</u> the words “and <i>Owner</i> ” after the words “ <i>Consultant</i> ” in the second and third lines.
SC10.2	2.3.3	<u>Delete</u> paragraph 2.3.3 in its entirety and <u>replace</u> it with the following: “2.3.3 The <i>Contractor</i> shall furnish promptly two copies to the <i>Consultant</i> and one copy to the <i>Owner</i> of all certificates and inspection reports relating to the <i>Work</i> .”
SC10.3	2.3.4	In paragraph 2.3.4 <u>add</u> the word “review” after the word “inspections” in the first and second lines of paragraph 2.3.4.
SC10.4	2.3.5	In paragraph 2.3.5 in the first line after the word “ <i>Consultant</i> ”, <u>add</u> “or the <i>Owner</i> ”.
SC10.5	2.3.8	<u>Add</u> a new paragraph 2.3.8 as follows: “2.3.8 The <i>Consultant</i> will conduct periodic reviews of the <i>Work</i> in progress, to determine general conformance with the requirements of the <i>Contract Documents</i> . Such reviews, or lack thereof, shall not give rise to any claims by the <i>Contractor</i> in connection with construction means, methods, techniques, sequences and procedures, nor in connection with construction safety at the <i>Place of Work</i> , responsibility for which belongs exclusively to the <i>Contractor</i> .”

SC11 GC 2.4 DEFECTIVE WORK

SC11.1	2.4.1	<u>Amend</u> GC 2.4.1 by inserting “, the <i>Owner</i> and/or its agent” in the first sentence following “rejected by the <i>Consultant</i> ”.
SC11.2	2.4.1.1 to 2.4.1.2	<u>Add</u> new paragraphs 2.4.1.1 and 2.4.1.2 as follows: “2.4.1.1 The <i>Contractor</i> shall rectify, in a manner acceptable to the <i>Consultant</i> and to the <i>Owner through the Consultant</i> all defective work and deficiencies throughout the <i>Work</i> , whether or not they are specifically identified by the <i>Consultant</i> . 2.4.1.2 The <i>Contractor</i> shall prioritize the correction of any defective work, which, in the sole discretion of the <i>Owner through the Consultant</i> , adversely affects the day to day operations of the <i>Owner</i> or which, in the sole discretion of the <i>Consultant</i> , adversely affects the progress of the <i>Work</i> .”

SC11.3	2.4.2	<p><u>Delete</u> paragraph 2.4.2 in its entirety and <u>replace</u> it with the following:</p> <p>“2.4.2 The <i>Contractor</i> shall promptly pay the <i>Owner</i> for costs incurred by the <i>Owner</i>, the <i>Owner’s</i> own forces or the <i>Owner’s</i> other contractors, for work destroyed or damaged or any alterations necessitated by the <i>Contractor’s</i> removal, replacement or re-execution of defective work.”</p>
SC11.4	2.4.4	<p><u>Add</u> new paragraph 2.4.4 as follows:</p> <p>“2.4.4 Neither acceptance of the <i>Work</i> by the <i>Consultant</i> or the <i>Owner</i>, nor any failure by the <i>Consultant</i> or the <i>Owner</i> to identify, observe or warn of defective <i>Work</i> or any deficiency in the <i>Work</i> shall relieve the <i>Contractor</i> from the sole responsibility for rectifying such defect or deficiency at the <i>Contractor’s</i> sole cost, even where such failure to identify, observe or warn is negligent.”</p>

PART 3 EXECUTION OF THE WORK

SC12 GC 3.1 CONTROL OF THE WORK

SC12.1	3.1.2	<p>Amend paragraph 3.1.2 by <u>inserting</u> the words “Construction Schedule” after the word “sequences”.</p>
SC12.2	3.1.3 & 3.1.4	<p><u>Add</u> new paragraphs 3.1.3 and 3.1.4 as follows:</p> <p>“3.1.3 Prior to commencing individual procurement, fabrication and construction activities, the <i>Contractor</i> shall verify at the <i>Place of the Work</i>, all relevant measurements and levels necessary for proper and complete fabrication, assembly and installation of the <i>Work</i> and shall further carefully compare such field measurements and conditions with the requirements of the <i>Contract Documents</i>. Where dimensions are not included or exact locations are not apparent, the <i>Contractor</i> shall immediately notify the <i>Consultant</i> in writing and obtain written instructions from the <i>Consultant</i> before proceedings with any part of the affected <i>Work</i>.</p> <p>3.1.4 Notwithstanding the provisions of paragraphs 3.1.1 and 3.1.2, the <i>Owner</i> shall have access to the site at all times to monitor all aspects of construction. Such access shall in no circumstances affect the obligations of the <i>Contractor</i> to fulfill its contractual obligations.”</p>

SC13 GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

SC13.1	3.2.2.1	<u>Delete</u> paragraph 3.2.2.1 in its entirety.
SC13.2	3.2.2.2	<u>Delete</u> paragraph 3.2.2.2 in its entirety.
SC13.3	3.2.2.3	<u>Delete</u> paragraph 3.2.2.3 in its entirety.
SC13.4	3.2.2.4	<u>Delete</u> paragraph 3.2.2.4 in its entirety.
SC13.5	3.2.3.2	<u>Delete</u> paragraph 3.2.3.2 and <u>replace</u> it with the following: “.2 co-ordinate and schedule the activities and work of other contractors and the <i>Owner's</i> own forces with the <i>Work</i> of the <i>Contractor</i> and connect as specified or shown in the <i>Contract Documents</i> .”
SC13.6	3.2.3.4	<u>Add</u> new paragraph 3.2.3.4 as follows: “.4 Subject to GC 9.4 CONSTRUCTION SAFETY, for the <i>Owner's</i> own forces and for other contractors, assume overall responsibility for compliance with all aspects of the applicable health and safety legislation in force at the <i>Place of the Work</i> , including all of the responsibilities of the “constructor”, pursuant to the <i>OHSA</i> .”

SC14 GC 3.3 TEMPORARY WORK

SC14.1	3.3.2	In paragraph 3.3.2, in the second line after the words “where required by law”, insert “or by the <i>Consultant</i> ”.
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SC15 GC 3.4 DOCUMENT REVIEW

SC15.1	3.4.1	<u>Delete</u> paragraph 3.4.1 in its entirety and <u>replace</u> it with the following: “3.4.1 The <i>Contractor</i> shall review the <i>Contract Documents</i> and shall report promptly to the <i>Consultant</i> any error, inconsistency, or omission the <i>Contractor</i> may discover. Such review by the <i>Contractor</i> shall be undertaken with the standard of care described in paragraph 3.14.1 of the <i>Contract</i> . Except for its obligation to make such review and report the result, the <i>Contractor</i> does not assume any responsibility to the <i>Owner</i> or to the <i>Consultant</i> for the accuracy of the <i>Contract Documents</i> . Provided it has exercised the degree of care and skill described in this paragraph 3.4.1, the <i>Contractor</i> shall not be liable for damage or costs resulting from such errors, inconsistencies, or omissions in the <i>Contract Documents</i> , which the <i>Contractor</i> could not
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		reasonably have discovered through the exercise of the required standard of care.”
SC15.2	3.4.2 & 3.4.3	<p><u>Add</u> new paragraphs 3.4.2 and 3.4.3 as follows:</p> <p>“3.4.2 If, at any time, the <i>Contractor</i> finds errors, inconsistencies, or omissions in the <i>Contract Documents</i> or has any doubt as to the meaning or intent of any part thereof, including laying out of the Work, the <i>Contractor</i> shall immediately notify the <i>Consultant</i>, and request instructions, a <i>Supplemental Instruction</i>, <i>Change Order</i>, or <i>Change Directive</i>, as the case may require, and the <i>Contractor</i> shall not proceed with the work affected until the <i>Contractor</i> has received such instructions, a <i>Supplemental Instruction</i>, <i>Change Order</i> or <i>Change Directive</i>. Neither the <i>Owner</i> nor the <i>Consultant</i> will be responsible for the consequences of any action of the <i>Contractor</i> based on oral instructions.</p> <p>3.4.3 Errors, inconsistencies and/or omissions in the <i>Drawings</i> and/or <i>Specifications</i> which do not allow completion of the <i>Work</i> of the <i>Contract</i> shall be brought to the <i>Consultant’s</i> attention prior to the execution of the <i>Contract</i> by means of an <i>RFI</i>.”</p>

SC16 GC 3.5 CONSTRUCTION SCHEDULE

SC16.1	3.5.1	<p><u>Delete</u> paragraph 3.5.1 in its entirety and <u>replace</u> with the following:</p> <p>“3.5.1 The <i>Contractor</i> shall:</p> <p>.1 within five (5) calendar days of receiving written confirmation of the award of the <i>Contract</i>, prepare and submit to the <i>Owner</i> and the <i>Consultant</i> for their review and approval, a construction schedule in the format indicated below that indicates the timing of the activities of the <i>Work</i> and provides sufficient detail of the critical events and their inter-relationship to demonstrate the <i>Work</i> will be performed in conformity with the <i>Contract Time</i> and in accordance with the <i>Contract Documents</i>. Such schedule is to include a delivery schedule for <i>Products</i> whose delivery is critical to the schedule for the <i>Work</i> or are required by the <i>Contract</i> to be included in a <i>Products</i> delivery schedule. The <i>Contractor</i> shall employ construction scheduling software, being the latest version of “Microsoft Project”, that permits the progress of the <i>Work</i> to be monitored in relation to the critical path established in the schedule. The <i>Contractor</i> shall provide such schedule and any successor or revised schedules in both electronic format and hard copy. Once accepted by the <i>Owner</i></p>
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		<p>and the <i>Consultant</i>, the construction schedule submitted by the <i>Contractor</i> shall become the baseline “Construction Schedule”;</p> <p>.2 provide the expertise and resources, such resources including manpower and equipment, as are necessary on a best efforts basis to maintain progress under the accepted baseline <i>Construction Schedule</i> or revised construction schedule accepted by the <i>Owner</i> pursuant to GC 3.5 CONSTRUCTION SCHEDULE, which includes without limitation, the <i>Contractor’s</i> use of all possible and, if necessary, extraordinary measures, to bring the progress of the <i>Work</i> into compliance with the <i>Construction Schedule</i>, such as (i) increasing the presence of its own forces at the <i>Place of the Work</i>; (ii) directing any <i>Subcontractors</i> or <i>Suppliers</i> to increase their labour forces and equipment; (iii) working overtime and extra shifts; and (iv) providing any additional supervision and coordination of the <i>Project</i>, all at the <i>Contractor’s</i> own cost and expense save and except where GC 6.5.1, 6.5.2, or 6.5.3 apply; and,</p> <p>.3 monitor the progress of the <i>Work</i> on a weekly basis relative to the baseline <i>Construction Schedule</i>, or any revised <i>Construction Schedule</i> accepted by the <i>Owner</i> pursuant to GC 3.5 CONSTRUCTION SCHEDULE, deliver a <i>Construction Schedule Update</i> to the <i>Consultant</i> and <i>Owner</i> with each application for payment, at a minimum, or as may be reasonably required by the <i>Consultant</i> and advise the <i>Consultant</i> and the <i>Owner</i> weekly in writing of any variation from the baseline or slippage in the schedule; and,</p> <p>.4 if after applying the expertise and resources required under paragraph 3.5.1.2, the <i>Contractor</i> forms the opinion that the slippage in schedule reported in paragraph 3.5.1.3 cannot be recovered by the <i>Contractor</i>, it shall, in the same notice provided under paragraph 3.5.1.3, indicate to the <i>Consultant</i> if the <i>Contractor</i> intends to apply for an extension of <i>Contract Time</i> as provided in PART 6 —CHANGES IN THE WORK; and,</p> <p>.5 ensure that the <i>Contract Price</i> shall include all costs required to phase or stage the <i>Work</i>.”</p>
SC16.2	3.5.2 & 3.5.3	<p><u>Add</u> new paragraphs 3.5.2 and 3.5.3 as follows:</p> <p>“3.5.2 If, at any time, it should appear to the <i>Owner</i> or the <i>Consultant</i> that the actual progress of the <i>Work</i> is behind schedule or is likely to</p>

		<p>become behind schedule, or if the <i>Contractor</i> has given notice of such to the <i>Owner</i> or the <i>Consultant</i> pursuant to subparagraph 3.5.1.3, the <i>Contractor</i> shall, either at the request of the <i>Owner</i> or the <i>Consultant</i>, or following giving notice pursuant to subparagraph 3.5.1.3, take appropriate steps to cause the actual progress of the <i>Work</i> to conform to the schedule or minimize the resulting delay. Within five (5) calendar days of the request by the <i>Owner</i> or the <i>Consultant</i> or the notice being given pursuant to subparagraph 3.5.1.3, the <i>Contractor</i> shall produce and present to the <i>Owner</i> and the <i>Consultant</i> a plan demonstrating how the <i>Contractor</i> will achieve the recovery of the last accepted schedule.</p> <p>3.5.3 The <i>Contractor</i> is responsible for performing the <i>Work</i> within the <i>Contract Time</i>. Any schedule submissions revised from the accepted baseline construction schedule or revised schedule accepted by the <i>Owner</i> pursuant to GC 3.5 CONSTRUCTION SCHEDULE, during construction are not deemed to be approved extensions to the <i>Contract Time</i>. All extensions to the <i>Contract Time</i> must be made in accordance with PART 6 – CHANGES IN THE WORK. “</p>
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SC17 GC 3.6 SUPERVISION

SC17.1	3.6.1	<p><u>Delete</u> paragraph 3.6.1 in its entirety and <u>replace</u> with the following:</p> <p>“3.6.1 The <i>Contractor</i> shall employ a competent full-time superintendent, acceptable to the <i>Owner</i> and <i>Consultant</i>, who shall be in full time attendance at the <i>Place of Work</i> while the <i>Work</i> is being performed. The superintendent shall not be changed by the <i>Contractor</i> without valid reason which shall be provided in writing and shall not be changed without prior consultation with and agreement by the <i>Owner</i> and the <i>Consultant</i>. The <i>Contractor</i> shall replace the superintendent within 7 <i>Working Days</i> of the <i>Owner’s</i> written notification, if the superintendent’s performance is not acceptable to the <i>Owner</i>. The <i>Contractor</i> shall provide the <i>Owner</i> and the <i>Consultant</i> with the names, addresses and telephone numbers of the superintendent referred to in this paragraph 3.6.1 and other responsible persons who may be contacted for emergency and other reasons during non-working hours.”</p>
SC17.2	3.6.2	<p><u>Delete</u> paragraph 3.6.2 in its entirety and <u>replace</u> with the following:</p> <p>“3.6.2 The superintendent, and any project manager appointed by the <i>Contractor</i>, shall represent the <i>Contractor</i> at the <i>Place of Work</i> and shall have full authority to act on written instructions given by the <i>Consultant</i> and/or the <i>Owner</i>. Instructions given to the superintendent</p>

		or the project manager shall be deemed to have been given to the <i>Contractor</i> and both the superintendent and any project manager shall have full authority to act on behalf of the <i>Contractor</i> and bind the <i>Contractor</i> in matters related to the <i>Contract</i> .”
SC17.3	3.6.3 to 3.6.6	<p><u>Add</u> new paragraph 3.6.3, 3.6.4, 3.6.5 and 3.6.6 as follows:</p> <p>“3.6.3 The <i>Owner</i> may, at any time during the course of the <i>Work</i>, request the replacement of the appointed representative(s). Immediately upon receipt of the request, the <i>Contractor</i> shall make arrangements to appoint an acceptable replacement, which is approved by the <i>Owner</i>.</p> <p>SC40 3.6.4 The supervisory staff assigned to the <i>Project</i> shall also be fully competent to implement efficiently all requirements for scheduling, coordination, field engineering, reviews, inspections and submittals defined in the <i>Specifications</i>, and have a minimum 5 years documented “Superintendent/Project Management” experience.</p> <p>SC41 3.6.5 The <i>Consultant and Owner</i> shall reserve the right to review the record of experience and credentials of supervisory staff assigned to the <i>Project</i> prior to commencement of the <i>Work</i>.</p> <p>SC42 3.6.6 A superintendent assigned to the <i>Work</i> shall be “Gold Seal Certified” as per the Canadian Construction Association; or a superintendent that can demonstrate the requisite experience and success related to the <i>Project</i> to the sole satisfaction of the <i>Owner</i>.”</p>

SC18 GC 3.7 SUBCONTRACTORS AND SUPPLIERS

SC18.1	3.7.1.1	In paragraph 3.7.1.1 <u>add</u> to the end of the second line the words “including any warranties and service agreements which extend beyond the term of the <i>Contract</i> .”
SC18.2	3.7.1.2	In subparagraph 3.7.1.2 after the words “the <i>Contract Documents</i> ” <u>add</u> the words “including any required surety bonding”.
SC18.3	3.7.2	<u>Delete</u> paragraph 3.7.2. in its entirety and <u>replace</u> it with the following: “3.7.2 The substitution of any <i>Subcontractor</i> and/or <i>Suppliers</i> after submission of the <i>Contractor’s</i> bid will not be accepted unless a valid reason is given in writing to and approved by the <i>Owner</i> , whose approval may be arbitrarily withheld. The reason for substitution must be provided to the <i>Owner</i> and to the original <i>Subcontractor</i> and/or <i>Supplier</i> and the <i>Subcontractor</i> and/or <i>Supplier</i> shall be given the opportunity to reply to the <i>Contractor</i> and <i>Owner</i> . The <i>Contractor</i> shall be fully aware of the capability of each <i>Subcontractor</i> and/or <i>Supplier</i> included in its bid, including but not limited to technical ability, financial stability and ability to maintain the proposed construction schedule.”
SC18.4	3.7.7, 3.7.8 & 3.7.9	<u>Add</u> new paragraphs 3.7.7, 3.7.8, and 3.7.9 as follows: “3.7.7 The <i>Consultant</i> or the <i>Owner</i> , acting reasonably, may from time to time require the <i>Contractor</i> to remove from the <i>Project</i> any personnel of the <i>Contractor</i> , including project managers, superintendents or <i>Subcontractors</i> . Such persons shall be replaced by the <i>Contractor</i> in a timely fashion to the satisfaction of the <i>Consultant</i> or the <i>Owner</i> , as the case may be, at no cost to the <i>Owner</i> . 3.7.8 Where provided in the <i>Contract</i> , the <i>Owner</i> may assign to the <i>Contractor</i> , and the <i>Contractor</i> agrees to accept, any contract procured by the <i>Owner</i> for <i>Work</i> or services required on the <i>Project</i> that has been pre-tendered or pre-negotiated by the <i>Owner</i> , and upon such assignment, the <i>Owner</i> shall have no further liability to any party for such contract. 3.7.9 The <i>Contractor</i> covenants that each subcontract or supply contract which the <i>Contractor</i> enters into for the purpose of performing the <i>Work</i> shall expressly provide for the assignment thereof to the <i>Owner</i> (at the option of the <i>Owner</i>) and the assumption by the <i>Owner</i> of the obligations of the <i>Contractor</i> thereunder, upon the termination of the <i>Contract</i> and upon written notice by the <i>Owner</i> to the other parties to such subcontracts or supply contracts, without the imposition of

		<p>further terms or conditions; provided, however, that until the <i>Owner</i> has given such notice, nothing herein contained shall be deemed to create any contractual or other liability upon the <i>Owner</i> for the performance of obligations under such subcontracts or supply contracts and the <i>Contractor</i> shall be fully responsible for all of its obligations and liabilities (if any) under such subcontracts and supply contracts.”</p>
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SC19 GC 3.8 LABOUR AND PRODUCTS

SC19.1	3.8.2	<p><u>Delete</u> paragraph 3.8.2 and <u>substitute</u> with the following:</p> <p>“3.8.2 <i>Products</i> 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, provincial and municipal building codes, fire safety standards, and all governmental authorities and regulatory agencies having jurisdiction at the <i>Place of the Work</i>, unless otherwise specified. <i>Products</i> which are not specified shall be of a quality consistent with those specified and their use acceptable to the <i>Consultant</i>. <i>Products</i> brought on to the <i>Place of the Work</i> by the <i>Contractor</i> shall be deemed to be the property of the <i>Owner</i>, but the <i>Owner</i> shall be under no liability for loss thereof or damage thereto arising from any cause whatsoever. The said <i>Products</i> shall be at the sole risk of the <i>Contractor</i>. Workmanship shall be, in every respect, first class and the <i>Work</i> shall be performed in accordance with the best modern industry practice.”</p>
SC19.2	3.8.3	<p><u>Amend</u> paragraph 3.8.3 by <u>adding</u> the words, “..., agents, <i>Subcontractors</i> and <i>Suppliers</i>...” after the word “employees” in the first line.</p>
SC19.3	3.8.4 to 3.8.8	<p><u>Add</u> new paragraphs 3.8.4, 3.8.5, 3.8.6, 3.8.7, and 3.8.8 as follows:</p> <p>“3.8.4 Upon receipt of a <i>Notice in Writing</i> from the <i>Owner</i>, the <i>Contractor</i> shall immediately remove from the <i>Place of the Work</i>, tradesmen and labourers or anyone whose conduct jeopardizes the safety of the <i>Owner’s</i> operations or who are considered by the <i>Owner</i> or the <i>Consultant</i> to be unskilled or otherwise objectionable. Immediately upon receipt of the request, the <i>Contractor</i> shall make arrangements to appoint an acceptable replacement.</p> <p>3.8.5 The <i>Contractor</i> shall cooperate with the <i>Owner</i> and its representatives and shall take all reasonable and necessary actions to maintain stable and harmonious labour relations with respect to the <i>Work</i> at the <i>Place of the Work</i>, including cooperation to attempt to avoid <i>Work</i></p>

		<p>stoppages, trade union jurisdictional disputes and other <i>Labour Disputes</i>. Any costs arising from labour disputes shall be at the sole expense of the <i>Contractor</i>.</p> <p>3.8.6 The cost for overtime required beyond the normal <i>Working Day</i> to complete individual construction operations of a continuous nature, such as pouring or finishing of concrete or similar work, or <i>Work</i> that the <i>Contractor</i> elects to perform at overtime rates without the <i>Owner</i> requesting it, shall not be chargeable to the <i>Owner</i>.</p> <p>3.8.7 All manufactured <i>Products</i> which are identified by their proprietary names or by part or catalogue number in the <i>Specifications</i> shall be used by the <i>Contractor</i>. No substitutes for such specified <i>Products</i> shall be used without the written approval of the <i>Owner</i> and the <i>Consultant</i>. Substitutes will only be considered by the <i>Consultant</i> when submitted in sufficient time to permit proper review and investigation. When requesting approval for the use of substitutes, the <i>Contractor</i> shall include in its submission any proposed change in the <i>Contract Price</i>. The <i>Contractor</i> shall use all proprietary <i>Products</i> in strict accordance with the manufacturer's directions. Where there is a choice of proprietary <i>Products</i> specified for one use, the <i>Contractor</i> may select any one of the <i>Products</i> so specified for this use.</p> <p>3.8.8 Materials, appliances, equipment and other <i>Products</i> are sometimes specified by reference to brand names, proprietary names, trademarks or symbols. In such cases, the name of a manufacturer, distributor, <i>Supplier</i> or dealer is sometimes given to assist the <i>Contractor</i> to find a source <i>Supplier</i>. This shall not relieve the <i>Contractor</i> from its responsibility from finding its own source of supply even if the source names no longer supplies the <i>Product</i> specified. If the <i>Contractor</i> is unable to obtain the specified <i>Product</i>, the <i>Contractor</i> shall supply a substitute product equal to or better than the specified <i>Product</i>, as approved by the <i>Consultant</i> with no extra compensation. Should the <i>Contractor</i> be unable to obtain a substitute <i>Product</i> equal to or superior to the specified <i>Product</i> and the <i>Owner</i> accepts a different <i>Product</i>, the <i>Contract Price</i> shall be adjusted accordingly, as approved by the <i>Consultant</i>."</p>
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SC20 GC 3.9 DOCUMENTS AT THE SITE

SC20.1	3.9.1	<u>Delete</u> paragraph 3.9.1 in its entirety and <u>substitute</u> the following:
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		<p>“3.9.1 The <i>Contractor</i> shall keep one copy of the current <i>Contract Documents</i>, <i>Supplemental Instructions</i>, contemplated <i>Change Orders</i>, <i>Change Orders</i>, <i>Change Directives</i>, cash allowance disbursement authorizations, reviewed <i>Shop Drawings</i>, submittals, reports and records of meeting at the <i>Place of the Work</i>, in good order and available to the <i>Owner</i> and <i>Consultant</i>.”</p>
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SC21 GC 3.10 SHOP DRAWINGS

SC21.1	3.10.1	<p><u>Delete</u> paragraph 3.10.1 in its entirety and <u>replace</u> with the following:</p> <p>“3.10.1 The <i>Contractor</i> shall provide shop drawings as described in the <i>Contract Documents</i> and as the <i>Consultant</i> may reasonably request.”</p>
SC21.2	3.10.3	<p><u>Delete</u> paragraph 3.10.3 and <u>replace</u> it with the following:</p> <p>“3.10.3 The <i>Contractor</i> shall prepare a <i>Shop Drawings</i> schedule acceptable to the <i>Owner</i> and the <i>Consultant</i> prior to the first application for payment. A draft of the proposed <i>Shop Drawings</i> schedule shall be submitted by the <i>Contractor</i> to the <i>Consultant</i> and the <i>Owner</i> for approval. The draft <i>Shop Drawings</i> schedule shall clearly indicate the phasing of <i>Shop Drawings</i> submissions. The <i>Contractor</i> shall periodically re-submit the <i>Shop Drawings</i> schedule to correspond to changes in the <i>Construction Schedule</i>.”</p>
SC21.3	3.10.9	<p><u>Delete</u> paragraph 3.10.9 in its entirety and <u>substitute</u> the following:</p> <p>“3.10.9 At the time of providing <i>Shop Drawings</i>, the <i>Contractor</i> shall advise the <i>Consultant</i> in writing of any deviations in <i>Shop Drawings</i> from the requirements of the <i>Contract Documents</i>. The <i>Consultant</i> shall indicate the acceptance of such deviation expressly in writing. Where manufacturers’ literature is submitted in lieu of scaled drawings, it shall be clearly marked in ink, to indicate the specific items for which review is requested.”</p>
SC21.4	3.10.1 3 to 3.10.1 7	<p><u>Add</u> new paragraphs 3.10.13, 3.10.14, 3.10.15, 3.10.16, and 3.10.17 as follows:</p> <p>“3.10.13 Reviewed <i>Shop Drawings</i> shall not authorize a change in the <i>Contract Price</i> and/or the <i>Contract Time</i>.</p> <p>3.10.14 Except where the parties have agreed to a different <i>Shop Drawings</i> schedule pursuant to paragraph 3.10.3, the <i>Contractor</i> shall comply with the requirements for <i>Shop Drawings</i> submissions stated in the <i>Specifications</i>.</p>

		<p>3.10.15 The <i>Contractor</i> shall not use the term “by others” on <i>Shop Drawings</i> or other submittals. The related trade, <i>Subcontractor</i> or <i>Supplier</i> shall be stated.</p> <p>3.10.16 Certain <i>Specifications</i> sections require the <i>Shop Drawings</i> to bear the seal and signature of a professional engineer. Such professional engineer must be registered in the jurisdiction of the <i>Place of the Work</i> and shall have expertise in the area of practice reflected in the <i>Shop Drawings</i>.</p> <p>3.10.17 The <i>Consultant</i> will review and return <i>Shop Drawings</i> and submittals in accordance with the schedule agreed upon in paragraph 3.10.3, The <i>Contractor</i> shall allow the <i>Consultant</i> a minimum of 10 <i>Working Days</i> to review <i>Shop Drawings</i> from the date of receipt. If resubmission of <i>Shop Drawings</i> is required, a further 10 <i>Working Day</i> period is required for the <i>Consultant’s</i> review.”</p>
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SC22 GC 3.11 USE OF THE WORK

SC22.1	3.11.1	In the second line between the words “permits, or” <u>add</u> , “by direction of the <i>Owner</i> or <i>Consultant</i> ”.
SC22.2	3.11.3	<p><u>Add</u> new paragraph 3.11.3 as follows:</p> <p>“3.11.3 The <i>Owner</i> shall have the right to enter or occupy the <i>Work</i> in whole or in part for the purpose of placing fittings and equipment, or for other use before <i>Substantial Performance of the Work</i>, if, in the opinion of the <i>Consultant</i>, such entry and occupation does not prevent or substantially interfere with the <i>Contractor</i> in the performance of the <i>Contract</i> within the <i>Contract Time</i>. Such entry or occupation shall neither be considered as acceptance of the <i>Work</i>, nor in any way relieve the <i>Contractor</i> from its responsibility to complete the <i>Contract</i>.”</p>

SC23 GC 3.12 CUTTING AND REMEDIAL WORK

SC23.1	3.12.5 & 3.12.6	<p><u>Add</u> new paragraphs 3.12.5 and 3.12.6 as follows:</p> <p>“3.12.5 Unless specifically stated otherwise in the <i>Specifications</i>, the <i>Contractor</i> shall do all cutting and making good necessary for the proper installation and performance of the <i>Work</i>.</p>
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		3.12.6 To avoid unnecessary cutting, the <i>Contractor</i> shall lay out its work and advise the <i>Subcontractors</i> , when necessary, where to leave holes for installation of pipes and other work.”
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SC24 GC 3.13 CLEAN UP

SC24.1	3.13.1	At the end of the paragraph 3.13.1, <u>add</u> the following: “The <i>Contractor</i> shall remove accumulated waste and debris at least once a week as a minimum or as required by the nature of the <i>Work</i> .”
SC24.2	3.13.2	In paragraph 3.13.2, in the fourth line <u>Add</u> the word “materials” between the word “tools” and the words “ <i>Construction Equipment</i> ”.
SC24.3	3.13.3	In paragraph 3.13.3, in the first and second lines <u>Add</u> the word “materials” between the word “tools” and the words “ <i>Construction Equipment</i> ” -and- In paragraph 3.13.3 <u>delete</u> the words “Prior to application for the final payment,” and <u>replace</u> them with “As a condition precedent to submitting its application for final payment,”.
SC24.4	3.13.4 & 3.13.5	Add new paragraphs 3.13.4 and 3.13.5 as follows: “3.13.4 The <i>Contractor</i> shall clean up garbage during and after construction and maintain the <i>Place of the Work</i> in a neat and orderly condition on a daily basis. Prior to leaving the <i>Place of the Work</i> and following completion of the <i>Work</i> , the <i>Contractor</i> shall make good all damage to the building and its components caused by the performance of the <i>Work</i> or by any <i>Subcontractor</i> or <i>Supplier</i> . The <i>Contractor</i> shall leave the <i>Place of the Work</i> in a clean and finished state; remove all <i>Construction Equipment</i> and materials; remove all paint, stains, labels, dirt, etc. from the <i>Place of the Work</i> ; and touch up all damaged painted areas (if applicable). The <i>Contractor</i> shall be responsible for restoring those areas of the <i>Place of the Work</i> , impacted by the <i>Work</i> , to their original condition.” 3.13.5 Without limitation to or waiver of the <i>Owner’s</i> other rights and remedies, the <i>Owner</i> shall have the right to back charge to the <i>Contractor</i> the cost of damage to the site caused by transportation in and out of the <i>Place of the Work</i> by the <i>Contractor</i> , <i>Subcontractors</i> or <i>Suppliers</i> , if not repaired before final payment. 3.13.6 The <i>Contractor</i> shall dispose of debris at a location and in a manner acceptable to the <i>Owner</i> (and to the authorities having jurisdiction at

		the <i>Place of the Work</i> and at the disposal area) and the <i>Contractor</i> shall cover containers with tarpaulins.”
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SC25 *NEW* GC 3.14 CONTRACTOR STANDARD OF CARE

SC25.1	3.14	<p><u>Add</u> a new GC 3.14 – CONTRACTOR STANDARD OF CARE as follows:</p> <p>“GC 3.14 CONTRACTOR STANDARD OF CARE</p> <p>“3.14.1 In performing its services and obligations under the <i>Contract</i>, the <i>Contractor</i> shall exercise the standard of care, skill and diligence that would normally be provided by an experienced and prudent contractor supplying similar services for similar projects. The <i>Contractor</i> acknowledges and agrees that throughout the <i>Contract</i>, the performance of the <i>Contractor’s</i> obligations, duties and responsibilities shall be interpreted in accordance with this standard. The <i>Contractor</i> shall exercise the same standard of care, skill and diligence in respect of any <i>Products</i>, personnel or procedures which it may recommend to the <i>Owner</i> or employ on the <i>Project</i>.</p> <p>3.14.2 The <i>Contractor</i> further represents, covenants and warrants to the <i>Owner</i> that:</p> <ul style="list-style-type: none"> .1 the personnel it assigns to the <i>Project</i> are appropriately experienced; .2 it has a sufficient staff of qualified and competent personnel to replace any of its appointed representatives, subject to the <i>Owner’s</i> approval, in the event of death, incapacity, removal or resignation; and .3 there are no pending, threatened or anticipated claims, liabilities or contingent liabilities that would have a material effect on the financial ability of the <i>Contractor</i> to perform its work under the <i>Contract</i>.”
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SC26 *NEW* GC 3.15 OCCUPANCY OF THE WORK

SC26.1	3.15.1	<p><u>Add</u> a new GC 3.15 – OCCUPANCY OF THE WORK as follows:</p> <p>“GC 3.15 OCCUPANCY OF THE WORK</p>
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		<p>3.15.1 The <i>Owner</i> reserves the right to take possession of and use for any intended purpose any portion or all of the undelivered portion of the <i>Project</i> even though the <i>Work</i> may not be substantially performed, progress of the work shall continue in such a way that it will not interfere with use of the occupied space or operation of the facility. The taking of possession or use of any such portion of the <i>Project</i> shall not be deemed to be the <i>Owner's</i> acknowledgement or acceptance of the <i>Work</i> or the <i>Project</i>, nor shall it relieve the <i>Contractor</i> of any of its obligations under the <i>Contract</i>.</p> <p>3.15.2 Whether the <i>Project</i> contemplates <i>Work</i> by way of renovations in buildings which will be in use or be occupied during the course of the <i>Work</i> or where the <i>Project</i> involves <i>Work</i> that is adjacent to a structure which is in use or is occupied, the <i>Contractor</i>, without in any way limiting its responsibilities under the <i>Contract</i>, shall take all reasonable steps to avoid interference with fire exits, building access and egress, continuity of electric power and all other utilities, the operation of HVAC systems, to suppress dust and noise and to avoid conditions likely to propagate mould or fungus of any kind and all other steps reasonably necessary to promote and maintain the safety and comfort of the users and occupants of such structures or adjacent structures."</p>
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PART 4 ALLOWANCES

SC27 GC 4.1

CASH ALLOWANCES

SC27.1	4.1.1	<u>Delete</u> the second sentence in paragraph 4.1.1.
SC27.2	4.1.4	<u>Delete</u> paragraph 4.1.4 in its entirety and <u>replace</u> it with the following: “4.1.4 Where the actual cost of the <i>Work</i> under any cash allowance exceeds the amount of the allowance, any unexpended amounts from other cash allowances shall be reallocated, at the <i>Consultant’s</i> direction, to cover the shortfall, and, in that case, there shall be no additional amount added to the <i>Contract Price</i> for overhead and profit. Only where the actual cost of the <i>Work</i> under all cash allowances exceeds the total amount of all cash allowances shall the <i>Contractor</i> be compensated for the excess incurred and substantiated, plus an amount for overhead and profit on the excess only, as set out in the <i>Contract Documents</i> .”
SC27.3	4.1.5	<u>Delete</u> paragraph 4.1.5 in its entirety and <u>substitute</u> the following: “4.1.5 The net amount of any unexpended cash allowances, after providing for any reallocations as contemplated in paragraph 4.1.4, shall be deducted from the <i>Contract Price</i> by <i>Change Order</i> without any adjustment for the <i>Contractor’s</i> overhead and profit on such amount.”
SC27.4	4.1.8 & 4.1.9	<u>Add</u> new paragraphs 4.1.8 and 4.1.9 as follows: “4.1.8 The <i>Owner</i> reserves the right to call, or to have the <i>Contractor</i> call, for competitive bids for portions of the <i>Work</i> , which are to be paid for from cash allowances. 4.1.9 Cash allowances cover the net cost to the <i>Contractor</i> of services, <i>Products</i> , <i>Construction Equipment</i> , freight, unloading, handling, storage, installation, provincial sales tax, and other authorized expenses incurred in performing any <i>Work</i> stipulated under the cash allowances but does not include any <i>Value Added Taxes</i> payable by the <i>Owner</i> and the <i>Contractor</i> .”

PART 5 PAYMENT

SC28 GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

SC28.1	5.1	<u>Delete</u> GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER and all paragraphs thereunder, including any reference to GC 5.1 throughout the <i>Contract</i> .
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SC29 GC 5.2 APPLICATIONS FOR PROGRESS PAYMENT

SC29.1	5.2.1	<p><u>Delete</u> paragraph 5.2.1 and <u>replace</u> it with the following:</p> <p>“5.2.1 Upon execution of the <i>Contract</i>, and in any event prior to the <i>Contractor</i> submitting its first application for payment, the <i>Owner</i> shall issue a purchase order to the <i>Contractor</i> for the performance of the <i>Contract</i>. The number indicated on such purchase order must be clearly identifiable on all applications for payment. Applications for payment shall be dated the last day of each month or an alternative day of each month agreed to in writing by the parties, with each month representing one payment period under the <i>Contract</i> (each a “Payment Period”). Within 3 calendar days of the end of each <i>Payment Period</i>, the <i>Contractor</i> will submit a draft application for payment to the <i>Owner</i> and the <i>Consultant</i>. Upon receipt of the draft application for payment, and within 7 calendar days, a representative of each of the <i>Contractor</i>, <i>Owner</i>, and the <i>Consultant</i> shall attend a meeting to discuss and review the work completed during the <i>Payment Period</i>, including quantities, if applicable (the “Pre-Invoice Submission Meeting”). In the event that the scheduled date for the <i>Pre-Invoice Submission Meeting</i> is not a <i>Working Day</i>, the <i>Pre-Invoice Submission Meeting</i> shall occur on the next <i>Working Day</i>. The <i>Contractor</i> shall bring with it to the <i>Pre-Invoice Submission Meeting</i> the following:</p> <ul style="list-style-type: none">.1 a copy of the draft application for payment;.2 any documents the <i>Contractor</i> is required to bring to the <i>Pre-Invoice Submission Meeting</i> as stipulated in the <i>Contract Documents</i> or as reasonably requested by the <i>Owner</i>; and.3 any other documents reasonably requested, in advance, by the <i>Owner</i> or the <i>Consultant</i>.”
SC29.2	5.2.2	<p><u>Delete</u> paragraph 5.2.2 in its entirety and <u>replace</u> it with the following:</p> <p>“5.2.2 Applications for payment shall be given in accordance with the following requirements:</p>

		<p>.1 within 5 calendar days following the <i>Pre-Invoice Submission Meeting</i>, the <i>Contractor</i> shall deliver its application for payment to the <i>Owner</i> and to the <i>Consultant</i> for <i>Work</i> performed during the <i>Payment Period</i> (“Proper Invoice Submission Date”) subject to the following:</p> <p>.1 if the fifth calendar day following the <i>Pre-Invoice Submission Meeting</i>, to which an invoice relates falls on a day that is not a <i>Working Day</i>, the <i>Proper Invoice Submission Date</i> shall be deemed to fall on the next <i>Working Day</i>.</p> <p>.2 the application for payment must be delivered to the <i>Owner</i> and to the <i>Consultant</i> in the same manner as a <i>Notice in Writing</i> during the hours of 9:00 am to 4:00pm (EST) on the <i>Proper Invoice Submission Date</i>. Delivery to the <i>Owner</i> shall be to the following address: finance-ap@wrdsb.ca</p> <p>.3 If an application for payment is received after 4:00 p.m. (EST) on the applicable <i>Proper Invoice Submission Date</i>, the application for payment will not be considered or reviewed by the <i>Owner</i> and <i>Consultant</i> until the next <i>Proper Invoice Submission Date</i>. Notwithstanding the foregoing, the <i>Owner</i> in its sole and absolute discretion may elect to accept an application for payment submitted after 4:00 p.m. on the applicable <i>Proper Invoice Submission Date</i>; however, such acceptance shall not be construed as a waiver of any of its rights or waive or release the <i>Contractor</i>’s obligations to strictly comply with the requirements prescribed in this subparagraph 5.2.2.3.</p> <p>.4 No applications for payment shall be accepted by the <i>Owner</i> prior to the <i>Proper Invoice Submission Date</i>.”</p>
SC29.3	5.2.3	<p><u>Delete</u> paragraph 5.2.3 and <u>replace</u> it with the following:</p> <p>“5.2.3 The amount claimed shall be for the value, proportionate to the amount of the <i>Contract</i>, of <i>Work</i> performed and <i>Products</i> delivered and incorporated into the <i>Work</i> as of the last date of the applicable <i>Payment Period</i>. Materials may also be deemed to be supplied to an improvement, for payment purposes, when, in the <i>Owner</i>’s opinion, they are placed and properly secured on the land on which the improvement is made, or placed upon land designated by the</p>

		<p><i>Owner</i> or agent of the <i>Owner</i>, but placing the materials on the land so designated does not, of itself, make that land subject to a lien. No amount claimed shall include products delivered and incorporated into the work, unless the products are free and clear of all security interests, liens and other claims of third parties. No amount claimed shall include <i>Products</i> delivered to the <i>Place of the Work</i> unless the <i>Products</i> are free and clear of all security interests, liens, and other claims of third parties.”</p>
SC29.4	5.2.4	<p>After the word “<i>Consultant</i>” in paragraph 5.2.4 <u>add</u> the words “and the <i>Owner</i>”</p>
SC29.5	5.2.5	<p>After the word “<i>Consultant</i>” in the first line of paragraph 5.2.5 <u>add</u> the words “or the <i>Owner</i>”</p> <p>-and-</p> <p>In the second line, <u>delete</u> the word “<i>Consultant</i>” and <u>replace</u> it with “<i>Owner</i>”.</p>
SC29.6	5.2.7	<p><u>Delete</u> paragraph 5.2.7 and <u>replace</u> it with the following:</p> <p>“5.2.7 The <i>Contractor</i> shall prepare and maintain current as-built drawings which shall consist of the <i>Drawings</i> and <i>Specifications</i> revised by the <i>Contractor</i> during the <i>Work</i>, showing changes to the <i>Drawings</i> and <i>Specifications</i>, which current as-built drawings shall be maintained by the <i>Contractor</i> and made available to the <i>Consultant</i> for review with each application for progress payment. The <i>Consultant</i> shall recommend to the <i>Owner</i> that the <i>Owner</i> retain a reasonable amount for the value of the as-built drawings not presented for review.”</p>

SC30 GC 5.3

PROGRESS PAYMENT

SC30.1	5.3.1.1	<p><u>Add</u> the following words to the end of subparagraph 5.3.1.1:</p> <p>“and confirm whether all of the criteria for a <i>Proper Invoice</i> are satisfied. If not, the application for payment will be returned to the <i>Contractor</i> with reasons from the <i>Owner</i> or the <i>Consultant</i> setting out why the application for payment is not a valid <i>Proper Invoice</i>.”</p>
SC30.2	5.3.1.2	<p><u>Delete</u> paragraph 5.3.1.2 and <u>replace</u> it with the following:</p> <p>“5.3.1.2 Following receipt of a <i>Proper Invoice</i>, the <i>Consultant</i>:</p> <p>.1 will issue to the <i>Owner</i> with a copy to the <i>Contractor</i>, a certificate for payment in the amount applied for, or</p>

		<p>.2 if the <i>Consultant</i> finds that such other amount is properly due under the application for payment or otherwise finds that the application for payment must be amended, it shall notify the <i>Owner</i> and prepare an applicable <i>Notice of Non-Payment</i> (Form 1.1) with reasons for the amendment.”</p>
SC30.3	5.3.1.3	<p><u>Delete</u> subparagraph 5.3.1.3 in its entirety and <u>substitute</u> as follows:</p> <p>“.3 the <i>Owner</i> shall make payment to the <i>Contractor</i> on account no later than 28 calendar days after the receipt by the <i>Owner</i> of a <i>Proper Invoice</i>, subject to the delivery by the <i>Owner</i> of a <i>Notice of Non-Payment</i> (Form 1.1).”</p>
SC30.4	5.3.2 to 5.3.7	<p><u>Add</u> new paragraphs 5.3.2, 5.3.3, 5.3.4, 5.3.5, 5.3.6, and 5.3.7 as follows:</p> <p>“5.3.2 All payments to the <i>Contractor</i> shall be processed using electronic funds transfer (“EFT”) and deposited directly to the <i>Contractor’s</i> bank account unless agreed to otherwise by the <i>Contractor</i> and the <i>Owner</i> in writing. Prior to the <i>Contractor</i> submitting its <i>Proper Invoice</i>, the <i>Owner</i> shall provide the <i>Contractor</i> with the necessary documents to facilitate EFT payments.</p> <p>5.3.3 Payment shall be deemed to have been made to the <i>Contractor</i> on the date in which funds are transferred via EFT to the <i>Contractor’s</i> bank account.</p> <p>5.3.4 In the event that the <i>Owner</i> disputes the amount claimed as payable in the <i>Proper Invoice</i>, within 14 calendar days of receipt of the <i>Proper Invoice</i>, the <i>Owner</i> shall provide to the <i>Contractor</i>, a <i>Notice of Non-Payment</i> (Form 1.1).</p> <p>5.3.5 Where the <i>Owner</i> has delivered a <i>Notice of Non-Payment</i>, as specified under paragraph 5.3.1.3 or 5.3.4, the <i>Owner</i> and the <i>Contractor</i> shall first engage in good faith negotiations to resolve the dispute. If within 10 calendar days following the issuance of a <i>Notice of Non-Payment</i>, the <i>Owner</i> and the <i>Contractor</i> cannot resolve the dispute, either party may issue a notice of adjudication in a form prescribed under the <i>Act</i>. The <i>Owner</i> and <i>Contractor</i> will then submit the dispute to <i>Adjudication</i> as set out under PART 8 – DISPUTE RESOLUTION.</p> <p>5.3.6 The amounts disputed and described under the <i>Notice of Non-Payment</i> shall be held by the <i>Owner</i> until all disputed amounts of the <i>Proper Invoice</i> have been resolved pursuant to PART 8 – DISPUTE</p>

		<p>RESOLUTION. Any portion of the <i>Proper Invoice</i> which is not the subject of the <i>Notice of Non-Payment</i> shall be payable within the time period set out in paragraph 5.3.1.3.</p> <p>5.3.7 The <i>Contractor</i> represents, warrants, and covenants to the <i>Owner</i> that it is familiar with its prompt payment and trust obligations under the <i>Act</i> and will take all required steps and measures to ensure that it complies with the applicable prompt payment and trust provisions under the <i>Act</i> including, without limitation, section 8.1 of the <i>Act</i>. Evidence of the <i>Contractor's</i> compliance under this GC 5.3.7, including evidence demonstrating that all EFTs by the <i>Owner</i> to the <i>Contractor</i> are kept in a bank account in the <i>Contractor's</i> name, will be made available to the <i>Owner</i> within 5 <i>Working Days</i> following receipt by the <i>Contractor</i> of a <i>Notice in Writing</i> making such request.”</p>
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SC31 GC 5.4

SUBSTANTIAL PERFORMANCE OF THE WORK

SC31.1	5.4.2	<p><u>Delete</u> paragraph 5.4.2 in its entirety and <u>substitute</u> the following:</p> <p>“5.4.2 The <i>Consultant</i> will review the <i>Work</i> to verify the validity of the application and shall promptly, and in any event, no later than 30 calendar days after receipt of the <i>Contractor's</i> complete deficiency list and application:</p> <ul style="list-style-type: none"> .1 prepare a final deficiency list incorporating all items to be completed or corrected. Each item is to have an indicated value for correction or completion. Determination of the value for <i>Substantial Performance</i> of the <i>Work</i> is defined in GC 5.10 – DEFICIENCY HOLDBACK. The final deficiency list complete with values is to be included with the <i>Consultant's</i> draft verification and shall be reviewed with the <i>Owner</i> prior to 5.4.2.2. .2 having completed 5.4.2.1: <ul style="list-style-type: none"> .1 the <i>Consultant</i> shall advise the <i>Contractor</i> in writing that the <i>Work</i> or the designated portion of the <i>Work</i> is not substantially performed and give reasons why, or .2 the <i>Consultant</i> shall state the date of <i>Substantial Performance of the Work</i> in a certificate and issue a copy of that certificate to each the <i>Owner</i> and the <i>Contractor</i>.”
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SC31.2	5.4.3	<p><u>Delete</u> paragraph 5.4.3 in its entirety and <u>substitute</u> the following:</p> <p>“5.4.3 Following the issuance of the certificate of <i>Substantial Performance of the Work</i> referenced in subparagraph 5.4.2.2.2:</p> <ol style="list-style-type: none"> .1 the <i>Contractor</i> shall complete the <i>Work</i> within sixty (60) calendar days; .2 no payments will be processed nor will any <i>Proper Invoices</i> be received by the <i>Owner</i> between <i>Substantial Performance of the Work</i> and the completion of the <i>Work</i>; .3 The <i>Owner</i> reserves the right to contract out any or all unfinished <i>Work</i> if it has not been completed within sixty (60) days of <i>Substantial Performance of the Work</i> without prejudice to any other right or remedy and without affecting the warranty period. The cost of completing the <i>Work</i> including <i>Owner</i> and <i>Consultant</i> wages and materials shall be deducted from the <i>Contract Price</i>.”
SC31.3	5.4.4 to 5.4.6	<p><u>Add</u> new paragraphs 5.4.4, 5.4.5 and 5.4.6:</p> <p>“5.4.4 The <i>Contractor</i> shall publish, in a construction trade newspaper in the area of the location of the <i>Work</i>, a copy of the certificate of <i>Substantial Performance of the Work</i> referred to in GC 5.4.2.2.2 within seven (7) days of receiving a copy of the certificate signed by the <i>Consultant</i>, and the <i>Contractor</i> shall provide suitable evidence of the publication to the <i>Consultant</i> and the <i>Owner</i>. If the <i>Contractor</i> fails to publish such notice, the <i>Owner</i> shall be at liberty to publish said certificate and back-charge the <i>Contractor</i> its reasonable costs for doing so.</p> <p>5.4.5 Prior to submitting its written application for <i>Substantial Performance of the Work</i>, the <i>Contractor</i> shall submit to the <i>Consultant</i>:</p> <ol style="list-style-type: none"> .1 statutory declaration in the form of CCDC 9; .2 WSIB clearance certificate showing good standing; .3 updated insurance certificate; .4 guarantees; .5 warranties; .6 certificates; .7 final testing and balancing reports; .8 distribution system diagrams; .9 spare parts;

		<p>.10 maintenance manuals; .11 samples; .12 reports and correspondence from authorities having jurisdiction in the <i>Place of the Work</i>; .13 shop drawings; .14 inspection certificates; .15 red-lined record drawings from the construction trailer in two copies.</p> <p>sand other materials or documentation required to be submitted under the <i>Contract</i>, together with written proof acceptable to the <i>Owner</i> and the <i>Consultant</i> that the <i>Work</i> has been substantially performed in conformance with the requirements of municipal, governmental, and utility authorities having jurisdiction in the <i>Place of the Work</i>. The <i>Consultant</i> shall refuse to certify <i>Substantial Performance of the Work</i> if the submittals referred to in this paragraph 5.4.5 are not provided by the <i>Contractor</i>.</p> <p>5.4.6 The <i>Owner</i> shall withhold, from amounts otherwise payable to the <i>Contractor</i>, an amount not to exceed one (1) percent of the <i>Contract Price</i> as security for the obligation of the <i>Contractor</i> to deliver two copies of the red-lined record drawings.”</p>
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SC32 GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK

SC32.1	5.5.1.3	<p><u>Add</u> new subparagraph 5.5.1.3 as follows:</p> <p>“.3 submit a statement that no written notices of lien have been received by the <i>Contractor</i>.”</p>
SC32.2	5.5.2	<p><u>Amend</u> paragraph 5.5.2 by <u>adding</u> the following sentence to the end of that paragraph:</p> <p>“Where after thirty (30) days following the publication of the certificate of <i>Substantial Performance of the Work</i>, pursuant to GC 5.4.4, the value of the <i>Work</i> remaining to be complete under the <i>Contract</i>, plus the estimated cost to repair any remaining deficiencies, exceeds the amount of the unpaid balance of the <i>Contract Price</i> (as determined by the <i>Payment Certifier</i>, acting reasonably), the <i>Owner</i> may publish a <i>Notice of Non-Payment</i> of holdback in accordance with the <i>Act</i> (Form 6) and retain an amount from the holdback to supplement the unpaid value of the <i>Contract Price</i> to secure the correction of deficiencies and completion of the <i>Work</i>. Such amounts may include all <i>Consultant</i> and <i>Owner</i> costs including any and all staff and material costs, design, tendering and contractor and supplier costs related to the correction of deficiencies and/or warranty claims.”</p>
SC32.3	5.5.3	<p><u>Delete</u> paragraph 5.5.3 in its entirety.</p>
SC32.4	5.5.4	<p><u>Delete</u> the first and second sentences in paragraph 5.5.4 and <u>replace</u> them with the following:</p> <p>“There being no claims for lien registered against title to the <i>Place of the Work</i>, as confirmed by a title search of the <i>Place of the Work</i> and there being no claims for lien or written notices of lien delivered to the <i>Owner</i>, the holdback amount authorized by the certificate for payment of the holdback amount issued by the <i>Consultant</i>, pursuant to GC 5.5.2, is due and payable on the 61st calendar day following the publication of the certificate of <i>Substantial Performance of the Work</i> referred to in GC 5.4.4.”</p>
SC32.5	5.5.5	<p><u>Delete</u> paragraph 5.5.5 in its entirety and <u>replace</u> it with the following:</p> <p>“5.5.5 Notwithstanding the <i>Owner’s</i> obligation to make payment of the holdback amount in accordance with GC 5.5.4, the processing of such payment remains subject to the <i>Owner’s</i> internal EFT timing limitations. The <i>Owner</i> covenants, and the <i>Contractor</i> agrees, that payment of the holdback shall be made by EFT at the first opportunity during the <i>Owner’s</i> normal processing of EFTs upon the holdback becoming due in accordance with GC 5.5.4.”</p>

SC33 GC 5.6 PROGRESSIVE RELEASE OF HOLDBACK

SC33.1	5.6	<u>Delete</u> GC 5.6 in its entirety.
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SC34 GC 5.7 FINAL PAYMENT

SC34.1	5.7.1	<p>In paragraph 5.7.1, <u>delete</u> the words “an application for final payment” and <u>replace</u> them with the following:</p> <p>“an application for final payment that complies with the requirements for a <i>Proper Invoice</i>, accompanied by any documents or materials not yet delivered pursuant to paragraph 5.4.5, together with complete and final as-built drawings. The <i>Contractor</i> shall also provided written certification that there are no outstanding claims, pending claims or future claims from the <i>Contractor</i> or their <i>Subcontractors</i> or <i>Suppliers</i>. The <i>Consultant</i> shall promptly inform the <i>Owner</i> of the receipt the application for final payment and confirm whether all of the criteria for a <i>Proper Invoice</i> are satisfied. If not, the application for payment will be returned to the <i>Contractor</i> with reasons from the <i>Owner</i> or the <i>Consultant</i> setting out why it is not a valid <i>Proper Invoice</i>.”</p>
SC34.2	5.7.2	<p><u>Delete</u> the words “10 calendar days” and <u>replace</u> them with “5 calendar days” from paragraph 5.7.2.</p> <p>-and-</p> <p><u>delete</u> the words “advise the <i>Contractor</i> in writing that the application is valid or give reasons why it is not valid.” and <u>replace</u> them with the following:</p> <p>.1 no later than 5 calendar days after the receipt of the <i>Proper Invoice</i> for final payment, the <i>Consultant</i> will issue to the <i>Owner</i> and copy to the <i>Contractor</i>, a certificate for final payment in the amount applied for, or</p> <p>.2 if the <i>Consultant</i> finds that such other amount is properly due under the <i>Proper Invoice</i> for final payment or otherwise finds that the <i>Proper Invoice</i> for final payment must be amended, it shall notify the <i>Owner</i> and prepare a draft <i>Notice of Non-Payment</i> (Form 1.1) with reasons for the amendment.”</p>
SC34.3	5.7.3	<p><u>Delete</u> paragraph 5.7.3 in its entirety and <u>replace</u> it with the following:</p> <p>“5.7.3 Where the <i>Owner</i> has delivered a <i>Notice of Non-Payment</i>, as specified under paragraph 5.7.2, the <i>Owner</i> and the <i>Contractor</i> shall first engage in good faith negotiations to resolve the dispute. If within</p>

		10 calendar days following the issuance of a <i>Notice of Non-Payment</i> , the <i>Owner</i> and <i>Contractor</i> cannot resolve the dispute, either party may issue a notice of adjudication in a form prescribed under the <i>Act</i> . The <i>Owner</i> and <i>Contractor</i> will then submit the dispute to <i>Adjudication</i> as set out under PART 8 – DISPUTE RESOLUTION.”
SC34.4	5.7.4	<u>Delete</u> from the second line of paragraph 5.7.4 the words, “5 calendar days after the issuance of” and <u>substitute</u> the words “28 calendar days after receipt of a <i>Proper Invoice</i> for final payment, subject to the delivery by the <i>Owner</i> of a <i>Notice of Non-Payment</i> (Form 1.1)”.
SC34.5	5.7.5	<u>Add</u> new paragraph 5.7.5 as follows: “5.7.5 The amounts disputed and described under the <i>Notice of Non-Payment</i> shall be held by the <i>Owner</i> until all disputed portions of the <i>Proper Invoice</i> for final payment have been resolved pursuant to PART 8 – DISPUTE RESOLUTION. Any portion of the <i>Proper Invoice</i> which is not the subject of the <i>Notice of Non-Payment</i> shall be payable within the time period set out in paragraph 5.7.4.”

SC35 GC 5.8 WITHHOLDING OF PAYMENT

SC35.1	5.8.1	<u>Delete</u> paragraph 5.8.1 and <u>replace</u> with the following: “5.8.1 If because of conditions reasonably beyond the control of the <i>Contractor</i> , there are items of work that cannot be performed, payment in full for that portion of the <i>Work</i> which has been performed as certified by the <i>Consultant</i> shall not be withheld or delayed by the <i>Owner</i> on account thereof, but the <i>Owner</i> may withhold, subject to its requirement to issue a <i>Notice of Non-Payment</i> under the <i>Act</i> , until the remaining portion of the <i>Work</i> is finished, only such an amount that the <i>Consultant</i> determines is sufficient and reasonable to cover the cost of performing such remaining work. The remaining work shall be valued as deficient work as defined in GC 5.10.1.”
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SC36 *NEW* GC 5.10 DEFICIENCY HOLDBACK

SC36.1	5.10.1	<p><u>Add</u> new GC 5.10 – DEFICIENCY HOLDBACK as follows:</p> <p>“GC 5.10 DEFICIENCY HOLDBACK</p> <p>5.10.1 Notwithstanding any provisions contained in the <i>Contract Documents</i> concerning certification and release of monies to the <i>Contractor</i>, the <i>Owner</i> reserves the right to establish a deficiency holdback, at the time of the review for <i>Substantial Performance of the Work</i>, based on a 200% dollar value of the deficiencies listed by the <i>Consultant</i>. The value of work outstanding for the calculation of <i>Substantial Performance of the Work</i> under the <i>Act</i> shall utilize the 100% dollar value. No individual deficiency will be valued at less than two hundred dollars (\$200.00). The deficiency holdback shall be due and payable to the <i>Contractor</i> on the 61st day following completion of all of the deficiencies listed by the <i>Consultant</i>, there being no claims for lien registered against the title to the <i>Place of the Work</i> issued in accordance with the <i>Act</i>, and less any amounts disputed under an <i>Owner’s Notice of Non-Payment</i> (Form 1.1).”</p>
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PART 6 CHANGES IN THE WORK

SC37 GC 6.1 OWNER’S RIGHT TO MAKE CHANGES

SC37.1	6.1.2	<p><u>Add</u> the following to the end of paragraph 6.1.2:</p> <p>“This requirement is of the essence and it is the express intention of the parties that any claims by the <i>Contractor</i> for a change in the <i>Contract Price</i> and/or <i>Contract Time</i> shall be barred unless there has been strict compliance with PART 6 - CHANGES IN THE WORK. No verbal dealings between the parties and no implied acceptance of alterations or additions to the <i>Work</i> and no claims that the <i>Owner</i> has been unjustly enriched by any alteration or addition to the <i>Work</i>, whether in fact there is any such unjust enrichment or not, shall be the basis of a claim for additional payment under this <i>Contract</i> or a claim for any extension of the <i>Contract Time</i>.”</p>
SC37.2	6.1.3 to 6.1.8	<p><u>Add</u> new paragraphs 6.1.3, 6.1.4, 6.1.5, 6.1.6, 6.1.7 and 6.1.8 as follows:</p> <p>“6.1.3 The <i>Contractor</i> agrees that changes resulting from construction coordination, including but not limited to, site surface conditions, site coordination, and <i>Subcontractor and Supplier</i> coordination are included in the <i>Contract Price</i> and the <i>Contractor</i> shall be precluded</p>

		<p>from making any claim for a change in the <i>Contract Price</i> as a result of such changes.</p> <p>6.1.4 Labour costs shall be actual, prevailing rates at the <i>Place of the Work</i> paid to workers, plus statutory charges on labour including WSIB, unemployment insurance, Canada pension, vacation pay, hospitalization and medical insurance. The <i>Contractor</i> shall provide these rates, when requested by the <i>Consultant</i>, for review and/or agreement.</p> <p>6.1.5 Quotations for changes to the <i>Work</i> shall only include <i>Direct Costs</i> and be accompanied by itemized breakdowns together with detailed, substantiating quotations or cost vouchers from <i>Subcontractors</i> and <i>Suppliers</i>, submitted in a format acceptable to the <i>Consultant</i> and shall include any <i>Direct Costs</i> associated with extensions in <i>Contract Time</i>.</p> <p>6.1.6 When both additions and deletions covering related <i>Work</i> or substitutions are involved in a change to the <i>Work</i>, payment, including <i>Overhead</i> and profit, shall be calculated on the basis of the net difference, if any, with respect to that change in the <i>Work</i>.</p> <p>6.1.7 No extension to the <i>Contract Time</i> shall be granted for changes in the <i>Work</i> unless the <i>Contractor</i> can clearly demonstrate that such changes significantly alter the overall construction schedule submitted at the commencement of the <i>Work</i>. Extensions of <i>Contract Time</i> and all associated costs, if approved, shall be included in the relevant <i>Change Order</i>.</p> <p>6.1.8 When a change in the <i>Work</i> is proposed or required, the <i>Contractor</i> shall within 10 calendar days submit to the <i>Consultant</i> for review a claim for a change in <i>Contract Price</i> and/or <i>Contract Time</i>. Should 10 calendar days be insufficient to prepare the submission, the <i>Contractor</i> shall within 5 calendar days, advise the <i>Consultant</i> in writing of the proposed date of submission of the claim. Claims submitted after the dates prescribed herein will not be considered."</p>
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SC38 GC 6.2 CHANGE ORDER

SC38.1	6.2.1	<p>In paragraph 6.2.1 after the last sentence in the paragraph <u>add</u> the following:</p> <p>“The adjustment in the <i>Contract Time</i> and the <i>Contract Price</i> shall include an adjustment, if any, for delay or for the impact that the change in the <i>Work</i> has on the <i>Work</i> of the <i>Contractor</i>, and once such adjustment is made, the <i>Contractor</i> shall be precluded from making any further claims for delay or impact with respect to the change in the <i>Work</i>.”</p>
SC38.2	6.2.3 to 6.2.5	<p><u>Add</u> new paragraphs 6.2.3, 6.2.4, and 6.2.5 as follows:</p> <p>“6.2.3 The value of a change shall be determined in one or more of the following methods as directed by the <i>Consultant</i>:</p> <ul style="list-style-type: none"> .1 by estimate and acceptance of a lump sum; .2 by negotiated unit prices which include the <i>Contractor's</i> overhead and profit, or; .3 by the actual <i>Direct Cost</i> to the <i>Owner</i>, such costs to be the actual cost after all credits included in the change have been deducted, plus the following ranges of mark-up on such costs: <ul style="list-style-type: none"> .1 Contractor on Work of their own forces, 5% overhead, 5 % profit .2 Sub-Contractor on Work of their own forces, 5% overhead, 5% profit .3 Contractor on Work of Sub-Contractor, 5% overhead only, <p style="margin-left: 40px;">the above includes for all site and office related overhead costs.</p> <p>6.2.4 All quotations shall include <i>Direct Costs</i> and be submitted in a complete manner listing:</p> <ul style="list-style-type: none"> .1 quantity of each material, .2 unit cost of each material, .3 man hours involved, .4 cost per hour,

		<p>.5 Subcontractor quotations submitted listing items 1 to 4 above and item 6 below.</p> <p>.6 mark-up.</p> <p>6.2.5 The <i>Owner</i> and the <i>Consultant</i> will not be responsible for delays to the <i>Work</i> resulting from late, incomplete or inadequately broken-down valuations submitted by the <i>Contractor</i>.”</p>
SC38.3		

SC39 GC 6.3 CHANGE DIRECTIVE

SC39.1	6.3.6.1	<p><u>Amend</u> paragraph 6.3.6.1 by deleting the final period and adding the following:</p> <p>“.1 Five percent (5%) for profit plus five percent (5%) for overhead on work by the <i>Contractor’s</i> own forces up to the value of \$15,000 and five percent (5%) for profit plus three percent (3%) for <i>Overhead</i> on work by the <i>Contractor’s</i> own forces in excess of \$15,000 and,</p> <p>.2 5 percent (5%) fee on amounts paid to <i>Subcontractors</i> or <i>Suppliers</i> under subparagraph 6.3.7.9 for changes up to the value of \$15,000 and five percent (5%) on changes over \$15,000.</p> <p>Unless a <i>Subcontractor’s</i> or <i>Supplier’s</i> price has been approved by the <i>Owner</i>, the <i>Subcontractor</i> or <i>Supplier</i> shall be entitled to its actual net cost as determined in accordance with paragraph 6.3.7, plus ten percent (5%) for profit and five percent (5%) for <i>Overhead</i> on such actual net cost for changes in the <i>Work</i>, up to the value of \$15,000 and five percent (5%) for profit and three percent (3%) for overhead on such actual net cost changes in the <i>Work</i> in excess of \$15,000.”</p>
SC39.2	6.3.6.2	<p><u>Delete</u> paragraph 6.3.6.2 and <u>replace</u> it with the following:</p> <p>“.2 If a change in the <i>Work</i> results in a net decrease in the <i>Contract Price</i> in excess of \$15,000 the amount of the credit shall be the net cost, with deduction for <i>Overhead</i> and profit. If a change in the <i>Work</i> results in a net decrease in the <i>Contract Price</i> of \$15,000 or less, the amount of the credit shall be the net cost, without deduction for <i>Overhead</i> or profit.</p>

SC39.3	6.3.7.1	In subparagraph 6.3.7.1 after the words “in the direct employ of the <i>Contractor</i> ” <u>add</u> the words “while directly engaged in the work attributable to the change”.
SC39.4	6.3.7	At the end of paragraph 6.3.7 <u>add</u> the following: “All other costs attributable to the change in the <i>Work</i> including the costs of all administrative or supervisory personnel are included in <i>Overhead</i> and profit calculated in accordance with the provisions of paragraph 6.1.5.”

SC40 GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

SC40.1	6.4.1	<p><u>Delete</u> paragraph 6.4.1 in its entirety and <u>replace</u> with the following:</p> <p>6.4.1.1 Prior to the submission of the bid on which the <i>Contract</i> was awarded, the <i>Contractor</i> confirms that it carefully investigated the <i>Place of the Work</i> and carried out such tests as it deemed appropriate and, in doing so, applied to that investigation the degree of care and skill required by paragraph 3.14.1. If the <i>Contractor</i> has not conducted such careful investigation, it is deemed to assume all risk of conditions or circumstances now existing or arising in the course of the <i>Work</i> which could make the <i>Work</i> more expensive or more difficult to perform than was contemplated at the time the <i>Contract</i> was executed. No allowances will be made for additional costs and no claims by the <i>Contractor</i> will be entertained in connection with conditions which could reasonably have been ascertained by such investigation or other due diligence undertaken prior to the execution of the <i>Contract</i>.</p> <p>6.4.1.2 No claim by the <i>Contractor</i> will be considered by the <i>Owner</i> or the <i>Consultant</i> in connection with conditions which could reasonably have been ascertained by such investigation or other due diligence undertaken prior to the execution of the <i>Contract</i>.</p> <p>6.4.1.3 The <i>Contractor</i> expressly acknowledges that, prior to the submission of the bid on which the <i>Contract</i> was awarded, the <i>Contractor</i> may have been prevented from carefully investigating the <i>Place of the Work</i> as a result of <i>Force Majeure</i>. Understanding such limitations, the <i>Contractor</i> proceeded with its bid. The <i>Contractor</i> shall not, therefore, make any claim arising from <i>Force Majeure</i> conditions which may have prevented the <i>Contractor</i> from fulfilling its obligations under this GC 6.4.”</p>
SC40.2	6.4.2	<u>Amend</u> paragraph 6.4.2 by <u>adding</u> a new first sentence as follows:

		<p>“Having regard to paragraph 6.4.1, if the <i>Contractor</i> believes that the conditions of the <i>Place of the Work</i> differ materially from those reasonably anticipated, differ materially from those indicated in the <i>Contract Documents</i> or were concealed from discovery notwithstanding the conduct of the investigation described in paragraph 6.4.1, it shall provide the <i>Owner</i> and the <i>Consultant</i> with <i>Notice in Writing</i> no later than five (5) <i>Working Days</i> after the first observation of such conditions.”</p> <p>-and-</p> <p><u>amend</u> the existing second sentence of paragraph 6.4.2 in the second line, following the word “materially” by <u>adding</u> the words “or were concealed from discovery notwithstanding the conduct of the investigation described in paragraph 6.4.1,”.</p>
SC40.3	6.4.3	<p><u>Delete</u> paragraph 6.4.3 in its entirety and <u>substitute</u> the following:</p> <p>“6.4.3 If the <i>Consultant</i> makes a finding pursuant to paragraph 6.4.2 that no change in the <i>Contract Price</i> or the <i>Contract Time</i> is justified, the <i>Consultant</i> shall report in writing the reasons for this finding to the <i>Owner</i> and the <i>Contractor</i>.”</p>
SC40.4	6.4.5	<p><u>Add</u> new paragraph 6.4.5 as follows:</p> <p>“6.4.5 No claims for additional compensation or for an extension of <i>Contract Time</i> shall be allowed if the <i>Contractor</i> fails to give <i>Notice in Writing</i> to the <i>Owner</i> or <i>Consultant</i>, as required by paragraph 6.4.2.”</p>

SC41 GC 6.5 DELAYS

SC41.1	6.5.1	<p>In paragraph 6.5.1 <u>delete</u> the words after the word “for” in the fourth line and <u>replace</u> them with the words “...reasonable <i>Direct Costs</i> directly flowing from the delay, but excluding any consequential, indirect or special damages (including, without limitation, loss of profits, loss of opportunity or loss of productivity).”</p>
SC41.2	6.5.2	<p>In paragraph 6.5.2,</p> <p><u>delete</u> the words “not issued as the result of an act or fault of the <i>Contractor</i> or any person employed or engaged by the <i>Contractor</i> directly or indirectly,” and <u>replace</u> them with “issued on account of a direct breach, violation, contravention, or a failure to abide by any laws, ordinances, rules, regulations, or codes by the <i>Owner</i>, the <i>Owner’s</i> other contractor(s), or the <i>Consultant</i>, and relating to the <i>Work</i> or the <i>Place of the Work</i>,”</p>

		<p>-and-</p> <p><u>delete</u> the words after the word “for” in the fourth line of paragraph 6.5.2, and <u>replace</u> them with the words “...reasonable <i>Direct Costs</i> directly flowing from the delay, but excluding any consequential, indirect or special damages (including, without limitation, loss of profits, loss of opportunity or loss of productivity).”</p>
SC41.3	6.5.3	<p><u>Delete</u> paragraph 6.5.3 in its entirety and <u>replace</u> with the following:</p> <p>“6.5.3 If either party is delayed in the performance of their obligations under this <i>Contract</i> by <i>Force Majeure</i>, then the <i>Contract Time</i> shall be extended for such reasonable time as the <i>Owner</i> and the <i>Contractor</i> shall agree. The extension of time shall not be less than the time lost as a result of the event causing the delay, unless the parties agree to a shorter extension. Neither party shall be entitled to payment for costs incurred by such delays. Upon reaching agreement on the extension of the <i>Contract Time</i> attributable to the <i>Force Majeure</i> event, the <i>Owner</i> and the <i>Contractor</i> shall execute a <i>Change Order</i> indicating the length of the extension to the <i>Contract Time</i> and confirming that there are no costs payable by the either party for the extension of <i>Contract Time</i>. However, if at the time an event of <i>Force Majeure</i> arises a party is in default of its obligations under the <i>Contract</i> and has received a notice of default pursuant to PART 7 – DEFAULT NOTICE, this paragraph 6.5.3 shall not excuse a party from its obligation to cure the default(s). For greater certainty, the defaulting party, to the extent possible, must continue to address and cure the default notwithstanding an event of <i>Force Majeure</i>.”</p>
SC41.4	6.5.4	<p><u>Delete</u> paragraph 6.5.4 in its entirety and <u>replace</u> it with the following:</p> <p>“6.5.4 No extension or compensation shall be made for delay or impact on the <i>Work</i> unless notice in writing of a claim is given to the <i>Consultant</i> not later than ten (10) <i>Working Days</i> after the commencement of the delays or impact on the <i>Work</i>, provided however, that, in the case of a continuing cause of delay or impact on the <i>Work</i>, only one notice of claim shall be necessary.”</p>

SC41.5	6.5.6 to 6.5.8	<p><u>Add</u> new paragraphs 6.5.6, 6.5.7 and 6.5.8 as follows:</p> <p>“6.5.6 If the <i>Contractor</i> is delayed in the performance of the <i>Work</i> by an act or omission of the <i>Contractor</i> or anyone directly or indirectly employed or engaged by the <i>Contractor</i>, or by any cause within the <i>Contractor’s</i> control, then (i) firstly, at its expense, and to the extent possible, the <i>Contractor</i> shall accelerate the work and/or provide overtime work to recover time lost by a delay arising under this paragraph 6.5.6, and (ii) secondly, where it is not possible for the <i>Contractor</i> to recover the time lost by implementing acceleration measures and/or overtime work, the <i>Contract Time</i> may be extended for such reasonable time as the <i>Owner</i> may decide in consultation with the <i>Consultant</i> and the <i>Contractor</i>. The <i>Owner</i> shall be reimbursed by the <i>Contractor</i> for all reasonable costs incurred by the <i>Owner</i> as the result of such delay, including, but not limited to, <i>Owner’s</i> staff costs, the cost of all additional services required by the <i>Owner</i> from the <i>Consultant</i> or any sub-consultants, project managers, or others employed or engaged by the <i>Owner</i>, and in particular, the costs of the <i>Consultant’s</i> services during the period between the date of <i>Substantial Performance of the Work</i> stated in Article A-1 herein, as the same may be extended through the provision of these General Conditions, and any later or actual date of <i>Substantial Performance of the Work</i> achieved by the <i>Contractor</i>.</p> <p>6.5.7 Without limiting the obligations of the <i>Contractor</i> described in GC 3.2 – CONSTRUCTION BY OWNER OR OTHER CONTRACTORS or GC 9.4 – CONSTRUCTION SAFETY, the <i>Owner</i> or <i>Consultant</i> may, by <i>Notice in Writing</i>, direct the <i>Contractor</i> to stop the <i>Work</i> where the <i>Owner</i> or <i>Consultant</i> determines that there is an imminent risk to the safety of persons or property at the <i>Place of the Work</i>. In the event that the <i>Contractor</i> receives such notice, it shall immediately stop the <i>Work</i> and secure the site. The <i>Contractor</i> shall not be entitled to an extension of the <i>Contract Time</i> or to an increase in the <i>Contract Price</i> unless the resulting delay, if any, would entitle the <i>Contractor</i> to an extension of the <i>Contact Time</i> or the reimbursement of the <i>Contractor’s</i> costs as provided in paragraphs 6.5.1, 6.5.2 or 6.5.3.</p> <p>6.5.8 No claim for delay shall be made and the <i>Contract Time</i> shall not be extended due to climatic conditions or arising from the <i>Contractor’s</i> efforts to maintain the <i>Construction Schedule</i>.”</p>
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PART 7 DEFAULT NOTICE

SC42 GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT

SC42.1	7.1.3.4	<p><u>Add</u> a new subparagraph 7.1.3.4 as follows:</p> <p>“.4 an “acceptable schedule” as referred to in subparagraph 7.1.3.2. means a schedule approved by the <i>Consultant</i> and the <i>Owner</i> wherein the default can be corrected within the balance of the <i>Contract Time</i> and shall not cause delay to any other aspect of the <i>Work</i> or the work of other contractors, and in no event shall it be deemed to give a right to extend the <i>Contract Time</i>.”</p>
SC42.2	7.1.4.1	<p><u>Delete</u> subparagraph 7.1.4.1 and <u>replace</u> it with the following:</p> <p>“.1 correct such default and deduct the cost, including <i>Owner's</i> expenses, thereof from any payment then or thereafter due the <i>Contractor</i>.”</p>
SC42.3	7.1.4.2	<p><u>Delete</u> subparagraph 7.1.4.2 and <u>replace</u> it with the following:</p> <p>“.2 by providing <i>Notice in Writing</i> to the <i>Contractor</i>, terminate the <i>Contractor's</i> right to continue with the <i>Work</i> in whole or in part or terminate the <i>Contract</i>, and publish a notice of termination (Form 8) in accordance with the <i>Act</i>.”</p>
SC42.4	7.1.5.3	<p>In subparagraph 7.1.5.3 <u>delete</u> the words: “however, if such cost of finishing the <i>Work</i> is less than the unpaid balance of the <i>Contract Price</i>, the <i>Owner</i> shall pay the <i>Contractor</i> the difference”</p>
SC42.5	7.1.6	<p><u>Delete</u> paragraph 7.1.6 in its entirety.</p>
SC42.6	7.1.6 to 7.1.10	<p><u>Add</u> new paragraphs 7.1.6, 7.1.7, 7.1.8, 7.1.9 and 7.1.10 as follows:</p> <p>“7.1.6 In addition to its right to terminate the <i>Contract</i> set out herein, the <i>Owner</i> may terminate this <i>Contract</i> at any time for any other reason and without cause upon giving the <i>Contractor</i> fifteen (15) <i>Working Days Notice in Writing</i> to that effect. In such event, the <i>Contractor</i> shall be entitled to be paid for all <i>Work</i> performed including reasonable profit, for loss sustained upon <i>Products</i> and <i>Construction Equipment</i>, and such other damages as the <i>Contractor</i> may have sustained as a result of the termination of the <i>Contract</i>, but in no event shall the <i>Contractor</i> be entitled to be compensated for any loss of profit on unperformed portions of the <i>Work</i>, or indirect, special, or consequential damages incurred.</p>

		<p>7.1.7 The <i>Owner</i> may suspend <i>Work</i> under this <i>Contract</i> at any time for any reason and without cause upon giving the <i>Contractor Notice in Writing</i> to that effect. In such event, the <i>Contractor</i> shall be entitled to be paid for all <i>Work</i> performed to the date of suspension and be compensated for all actual costs incurred arising from the suspension, including reasonable profit, for loss sustained upon <i>Products</i> and <i>Construction Equipment</i>, and such other damages as the <i>Contractor</i> may have sustained as a result of the suspension of the <i>Work</i>, but in no event shall the <i>Contractor</i> be entitled to be compensated for any indirect, special, or consequential damages incurred. In the event that the suspension continues for more than thirty (30) calendar days, the <i>Contract</i> shall be deemed to be terminated and the provisions of paragraph 7.1.6 shall apply.</p> <p>7.1.8 In the case of either a termination of the <i>Contract</i> or a suspension of the <i>Work</i> under GC 7.1 - OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK, OR TERMINATE THE CONTRACT or GC 7.2 - CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT, the <i>Contractor</i> shall use its best commercial efforts to mitigate the financial consequences to the <i>Owner</i> arising out of the termination or suspension, as the case may be.</p> <p>7.1.9 Upon the resumption of the <i>Work</i> following a suspension under GC 7.1 - OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK, OR TERMINATE THE CONTRACT or GC 7.2 - CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT, the <i>Contractor</i> will endeavour to minimize the delay and financial consequences arising out of the suspension.</p> <p>7.1.10 The <i>Contractor's</i> obligations under the <i>Contract</i> as to quality, correction, and warranty of the <i>Work</i> performed by the <i>Contractor</i> up to the time of termination or suspension shall continue after such termination of the <i>Contract</i> or suspension of the <i>Work</i>."</p>
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SC43 GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

SC43.1	7.2.2	<p>Delete paragraph 7.2.2 and <u>replace</u> it with the following:</p> <p>"7.2.2 If the <i>Work</i> is suspended or otherwise delayed for a period of 40 consecutive <i>Working Days</i> or more under a stop work order issued</p>
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		by a court or other public authority on account of a breach, violation, contravention, or a failure to abide by any laws, ordinances, rules, regulations, or codes directly by the <i>Owner</i> , the <i>Owner's</i> other contractor(s), or the <i>Consultant</i> , and relating to the <i>Work</i> or the <i>Place of the Work</i> , the <i>Contractor</i> may, without prejudice to any other right or remedy the <i>Contractor</i> may have, terminate the <i>Contract</i> by giving the <i>Owner</i> Notice in <i>Writing</i> to that effect.”
SC43.2	7.2.3.1	<u>Delete</u> subparagraph 7.2.3.1 in its entirety.
SC43.3	7.2.3.2	<u>Delete</u> subparagraph 7.2.3.2 in its entirety.
SC43.4	7.2.3.4	In subparagraph 7.2.3.4, <u>delete</u> the words "except for GC 5.1 - FINANCING INFORMATION REQUIRED OF THE OWNER".
SC43.5	7.2.5	<u>Renumber</u> paragraph 7.2.5 as paragraph 7.2.6. and <u>add</u> a new paragraph 7.2.5 as follows: “7.2.5 If the default cannot be corrected within the 5 <i>Working Days</i> specified in paragraph 7.2.4, the <i>Owner</i> shall be deemed to have cured the default if it: .1 commences correction of the default within the specified time; .2 provides the <i>Contractor</i> with an acceptable schedule for such correction; and, .3 completes the correction in accordance with such schedule.”

SC43.6	7.2.6	<p><u>Delete</u> paragraph 7.2.6 entirely and <u>replace</u> with the following:</p> <p>“7.2.6 If the <i>Contractor</i> terminates the <i>Contract</i> under the conditions described in GC 7.2 – CONTRACTOR’S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT, the <i>Contractor</i> shall be entitled to be paid for all <i>Work</i> performed to the date of termination, as determined by the <i>Consultant</i>. The <i>Contractor</i> shall also be entitled to recover the direct costs associated with termination, including the costs of demobilization and losses sustained on <i>Products</i> and <i>Construction Equipment</i>. The <i>Contractor</i> shall not be entitled to any recovery for any special, indirect or consequential losses, including loss of profit.”</p>
SC43.7	7.2.7 to 7.2.9	<p><u>Add</u> new paragraphs 7.2.7, 7.2.8 and 7.2.9 as follows:</p> <p>“7.2.7 The <i>Contractor</i> shall not be entitled to give notice of the <i>Owner’s</i> default or terminate the <i>Contract</i> in the event the <i>Owner</i> withholds certificates or payment or both in accordance with the <i>Contract</i> because of:</p> <ul style="list-style-type: none">.1 the <i>Contractor’s</i> failure to pay all legitimate claims promptly, or.2 the failure of the <i>Contractor</i> to discharge construction liens which are registered against the title to the <i>Place of the Work</i>. <p>7.2.8 The <i>Contractor’s</i> obligations under the <i>Contract</i> as to quality, correction and warranty of the <i>Work</i> performed by the <i>Contractor</i> up to the effective date of termination shall continue in force and shall survive termination of this <i>Contract</i> by the <i>Contractor</i>.</p> <p>7.2.9 If the <i>Contractor</i> suspends the <i>Work</i> or terminates the <i>Contract</i> as provided for in GC 7.2 – CONTRACTOR’S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT, the <i>Contractor</i> shall ensure the site and the <i>Work</i> are left in a safe, secure condition as required by authorities having jurisdiction at the <i>Place of the Work</i> and the <i>Contract Documents</i>.”</p>

SC44 GC 8.1

AUTHORITY OF THE CONSULTANT

SC44.1	8.1.3	<p><u>Delete</u> paragraph 8.1.3 in its entirety and <u>substitute</u> as follows:</p> <p>“8.1.3 If a dispute is not resolved promptly, the <i>Consultant</i> will give such instruction as in the <i>Consultant’s</i> opinion are necessary for the proper performance of the <i>Work</i> and to prevent delays pending settlement of the dispute. The parties shall act immediately according to such instructions, it being understood that by doing so neither party will jeopardize any claim the party may have.”</p>
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SC45 GC 8.2

NEGOTIATION, MEDIATION AND ARBITRATION

SC45.1	8.2.1	<p><u>Amend</u> paragraph 8.2.1 by changing part of the second line from “shall appoint a <i>Project Mediator</i>” to “may appoint a <i>Project Mediator</i>, except that such an appointment shall only be made if both the <i>Owner</i> and the <i>Contractor</i> agree.”</p>
SC45.2	8.2.4	<p><u>Amend</u> paragraph 8.2.4 by changing part of the second line from “the parties shall request the <i>Project Mediator</i>” to “and subject to paragraph 8.2.1 the parties may request the <i>Project Mediator</i>”.</p>
SC45.3	8.2.6 to 8.2.8	<p><u>Delete</u> paragraphs 8.2.6, 8.2.7 and 8.2.8 in their entirety.</p>
SC45.4	8.2.6	<p><u>Add</u> new paragraph 8.2.6 as follows:</p> <p>“8.2.6 The dispute may be finally resolved by arbitration under the Rules for Arbitration of Construction Disputes as provided in CCDC 40 in effect at the time of bid closing, provided that both the <i>Contractor</i> and the <i>Owner</i> agree. If the <i>Contractor</i> and the <i>Owner</i> agree to resolve the dispute by arbitration, the arbitration shall be conducted in the jurisdiction of the <i>Place of the Work</i>.”</p>
SC45.5	8.2.9, 8.2.1 0 & 8.2.1 1	<p><u>Add</u> a new paragraphs 8.2.9, 8.2.10, and 8.2.11 as follows:</p> <p>“8.2.9 Prior to delivering a notice of <i>Adjudication</i> in a form prescribed by the <i>Act</i>, the parties agree to first address all disputes by attending at least one meeting with the <i>Owner’s</i> representative, the <i>Consultant’s</i> representative, and the <i>Contractor’s</i> representative, prior to commencing an <i>Adjudication</i>. The parties agree that such steps will be taken to resolve any disputes in a timely and cost effective manner. If a resolution to the dispute(s) is not made at such a meeting, any party who plans to commence an <i>Adjudication</i> shall provide the other party with 5 <i>Working Days’ Notice in Writing</i> of its intention to issue a notice of <i>Adjudication</i>.</p>

		<p>8.2.10 Other than where the <i>Contractor</i> is obliged to commence an <i>Adjudication</i> pursuant to an undertaking under the <i>Act</i>, neither the <i>Owner</i> nor the <i>Contractor</i> shall commence an <i>Adjudication</i> during the <i>Restricted Period</i>.</p> <p>8.2.11 Where either party has delivered a notice of <i>Adjudication</i> in a form prescribed by the <i>Act</i>, the procedures and rules set out under the <i>Act</i> and the regulations thereto shall govern the <i>Adjudication</i>.”</p>
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SC46 GC 9.1 PROTECTION OF WORK AND PROPERTY

SC46.1	9.1.1.1	<p><u>Delete</u> subparagraph 9.1.1.1 in its entirety and <u>substitute</u> the following:</p> <p>“.1 errors in the <i>Contract Documents</i> which the <i>Contractor</i> could not have discovered applying the standard of care described in paragraph 3.14.1;”</p>
SC46.2	9.1.2	<p><u>Delete</u> paragraph 9.1.2 in its entirety and <u>substitute</u> as follows:</p> <p>“9.1.2 Before commencing any <i>Work</i>, the <i>Contractor</i> shall determine the locations of all underground or hidden utilities and structures indicated in or inferable from the <i>Contract Documents</i>, or that are inferable from an inspection of the <i>Place of the Work</i> exercising the degree of care and skill described in paragraph 3.14.1.”</p>
SC46.3	9.1.5	<p><u>Add</u> new paragraph 9.1.5 as follows:</p> <p>“9.1.5 With respect to any damage to which paragraphs 9.1.3 or 9.1.4 apply, the <i>Contractor</i> shall neither undertake to repair or replace any damage whatsoever to the work of other contractors, or to adjoining property, nor acknowledge that the same was caused or occasioned by the <i>Contractor</i>, without first consulting the <i>Owner</i> and receiving written instructions as to the course of action to be followed from either the <i>Owner</i> or the <i>Consultant</i>. Where, however, there is danger to life, the environment, or public safety, the <i>Contractor</i> shall take such emergency action as it deems necessary to remove the danger.”</p>

SC47 GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

SC47.1	9.2.5.5	<p><u>Add</u> a new subparagraph 9.2.5.5 as follows:</p> <p>“.5 in addition to the steps described in subparagraph 9.2.5.3, take any further steps it deems necessary to mitigate or stabilize any conditions resulting from encountering toxic or hazardous substances or materials.”</p>
SC47.2	9.2.6	<p><u>Add</u> the following to paragraph 9.2.6, after the word “responsible” in the second line:</p> <p>“or whether any toxic or hazardous substances or materials already at the <i>Place of the Work</i> (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the <i>Contractor</i> or anyone for whom the <i>Contractor</i> 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 damages to the property of the <i>Owner</i> or others,”.</p>
SC47.3	9.2.8	<p><u>Add</u> the following to paragraph 9.2.8, after the word “responsible” in the second line:</p> <p>“or whether any toxic or hazardous substances or materials already at the <i>Place of the Work</i> (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the <i>Contractor</i> or anyone for whom the <i>Contractor</i> 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 damages to the property of the <i>Owner</i> or others,”.</p>
SC47.4	9.2.10	<p><u>Add</u> new paragraph 9.2.10 as follows:</p> <p>“9.2.10 The <i>Contractor</i>, <i>Subcontractors</i> and <i>Suppliers</i> shall not bring on to the <i>Place of the Work</i> any toxic or hazardous substances and materials except as required in order to perform the <i>Work</i>. If such toxic or hazardous substances or materials are required, storage in quantities sufficient to allow work to proceed to the end of any current work week only shall be permitted. All such toxic and hazardous materials and substances shall be handled and disposed of only in accordance with all laws and regulations that are applicable at the <i>Place of the Work</i>.”</p>

SC48 GC 9.4 CONSTRUCTION SAFETY

SC48.1	9.4.1	<p><u>Delete</u> paragraph 9.4.1 in its entirety and <u>substitute</u> as follows:</p> <p>“9.4.1 The <i>Contractor</i> shall be solely responsible for construction safety at the <i>Place of the Work</i> and for compliance with the rules, regulations, and practices required by the <i>OHSA</i>, including, but not limited to those of the "constructor", and shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the <i>Work</i>. Without limiting the foregoing, the <i>Contractor</i> shall be solely responsible for construction safety in respect of its <i>Consultants</i>, other <i>Consultants</i>, <i>Subcontractors</i> and <i>Suppliers</i>, the <i>Owner's</i> own forces, and other contractors, subcontractors, and suppliers during the course of the <i>Project</i>.”</p>
SC48.2	9.4.2 to 9.4.1 0	<p><u>Add</u> new paragraphs 9.4.2 to 9.4.10 as follows:</p> <p>9.4.2 Prior to the commencement of the <i>Work</i>, the <i>Contractor</i> shall submit to the <i>Owner</i>:</p> <ul style="list-style-type: none"> .1 the evidence of workers' compensation compliance required by GC 10.4.1; .2 copies of the <i>Contractor's</i> insurance policies having application to the <i>Project</i> or certificates of insurance, at the option of the <i>Owner</i>; .3 documentation setting out the <i>Contractor's</i> in-house safety programs; .4 a copy of the "Notice of Project" filed with the Ministry of Labour; .5 copies of any documentation or notices to be filed or delivered to the authorities having jurisdiction for the regulation of occupational health and safety at the <i>Place of the Work</i>. <p>9.4.3 The <i>Contractor</i> shall indemnify and save harmless the <i>Owner</i>, its agents, trustees, officers, directors, employees, consultants, successors, appointees, and assigns from and against the consequences of any and all safety infractions committed by the <i>Contractor</i> under the occupational health and safety legislation in force at the <i>Place of the Work</i> including the payment of legal fees and disbursements on a substantial indemnity basis.</p>

	<p>9.4.4 The <i>Owner</i> undertakes to include in its contracts with other contractors and in its instructions to its own forces the requirement that the other contractor or its own forces, as the case may be, comply with the policies and procedures of and the directions and instructions from the <i>Contractor</i> with respect to occupational health and safety and related matters.</p> <p>9.4.5 If the <i>Owner</i> is of the reasonable opinion that the <i>Contractor</i> has not taken such precautions as are necessary to ensure compliance with the requirements of paragraph 9.4.1, the <i>Owner</i> may take any remedial measures which it deems necessary, including stopping the performance of all or any portion of the <i>Work</i>, and the <i>Owner</i> may use its employees, the <i>Contractor</i>, any <i>Subcontractor</i> or any other contractors to perform such remedial measures.</p> <p>9.4.6 The <i>Contractor</i> shall file any notices or any similar document required pursuant to the <i>Contract</i> or the safety regulations in force at the <i>Place of the Work</i>. This duty of the <i>Contractor</i> will be considered to be included in the <i>Work</i> and no separate payment therefore will be made to the <i>Contractor</i>.</p> <p>9.4.7 Unless otherwise provided in the <i>Contract Documents</i>, the <i>Contractor</i> shall develop, maintain and supervise for the duration of the <i>Work</i> a comprehensive safety program that will effectively incorporate and implement all required safety precautions. The program shall, at a minimum, respond fully to the applicable safety regulations and general construction practices for the safety of persons or property, including, without limitation, any general safety rules and regulations of the <i>Owner</i> and any workers' compensation or occupational health and safety statutes or regulations in force at the <i>Place of the Work</i>.</p> <p>9.4.8 The <i>Contractor</i> shall provide a copy of the safety program described in paragraph 9.4.7 hereof to the <i>Consultant</i> for delivery to the <i>Owner</i> prior to the commencement of the <i>Work</i>, and shall, ensure, as far as it is reasonably practical to do so, that every employer and worker performing work in respect of the <i>Project</i> complies with such program.</p> <p>9.4.9 The <i>Contractor</i> shall arrange regular safety meetings, and shall supply and maintain, at its own expense, at its office or other well-known place at the job site, safety equipment necessary to protect the workers and general public against accident or injury as prescribed by the authorities having jurisdiction at the <i>Place of the Work</i>, including, without limitation, articles necessary for</p>
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		<p>administering first-aid to any person and an emergency procedure for the immediate removal of any injured person to a hospital or a doctor's care.</p> <p>9.4.10 The <i>Contractor</i> shall promptly report in writing to the <i>Owner</i> and the <i>Consultant</i> all accidents of any sort arising out of or in connection with the performance of the <i>Work</i>, whether on or adjacent to the job site, giving full details and statement of witnesses. If death or serious injuries or damages are caused, the accident shall be promptly reported by the <i>Contractor</i> to the <i>Owner</i> and the <i>Consultant</i> by telephone or messenger in addition to any reporting required under the applicable safety regulations."</p>
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SC49 GC 10.1 TAXES AND DUTIES

SC49.1	10.1.2	<p><u>Amend</u> paragraph 10.1.2 by <u>adding</u> the following sentence to the end of the paragraph:</p> <p>"For greater certainty, the <i>Contractor</i> shall not be entitled to any mark-up for overhead or profit on any increase in such taxes and duties and the <i>Owner</i> shall not be entitled to any credit relating to mark-up for overhead or profit on any decrease in such taxes. The <i>Contractor</i> shall provide a detailed breakdown of <u>Additional</u> taxes if requested by the <i>Owner</i> in a form satisfactory to the <i>Owner</i>."</p>
SC49.2	10.1.3	<p><u>Add</u> new paragraph 10.1.3 as follows:</p> <p>"10.1.3 Where the <i>Owner</i> is entitled to an exemption or a recovery of sales taxes, customs duties, excise taxes or <i>Value Added Taxes</i> applicable to the <i>Contract</i>, the <i>Contractor</i> shall, at the request of the <i>Owner</i>, assist with the application for any exemption, recovery or refund of all such taxes and duties and all amounts recovered or exemptions obtained shall be for the sole benefit of the <i>Owner</i>. The <i>Contractor</i> agrees to endorse over to the <i>Owner</i> any cheques received from the federal or provincial governments, or any other taxing authority, as may be required to give effect to this paragraph."</p>

SC50 GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

SC50.1	10.2.5	<p><u>Amend</u> paragraph 10.2.5 by <u>adding</u> the words “Subject to paragraph 3.4” at the beginning of the paragraph.</p> <p>-and-</p> <p><u>Add</u> the following to the end of the second sentence:</p> <p>“...and no further <i>Work</i> on the affected components of the <i>Contract</i> shall proceed until these directives have been obtained by the <i>Contractor</i> from the <i>Consultant</i>.”</p>
SC50.2	10.2.6	<p><u>Amend</u> paragraph 10.2.6 by <u>adding</u> the following sentence to the end of the paragraph:</p> <p>“In the event the <i>Owner</i> suffers loss or damage as a result of the <i>Contractor’s</i> failure to comply with paragraph 10.2.5 and notwithstanding any limitations described in paragraph 12.1.1, the <i>Contractor</i> agrees to indemnify and to hold harmless the <i>Owner</i> and the <i>Consultant</i> from and against any claims, demands, losses, costs, damages, actions suits or proceedings resulting from such failure by the <i>Contractor</i>.”</p>
SC50.3	10.2.7	<p><u>Amend</u> paragraph 10.2.7 by inserting the words “which changes were not, or could not have reasonably been known to the <i>Owner</i> or to the <i>Contractor</i>, as applicable, at the time of bid closing and which changes did not arise as a result of a public emergency or other <i>Force Majeure</i> event” to the second line, after the words “authorities having jurisdiction”.</p>
SC50.4	10.2.8	<p><u>Add</u> new paragraph 10.2.8 as follows:</p> <p>“10.2.8 The <i>Contractor</i> shall furnish all certificates that are required or given by the appropriate governmental authorities as evidence that the <i>Work</i> as installed conforms with the laws and regulations of authorities having jurisdiction, including certificates of compliance for the <i>Owner’s</i> occupancy or partial occupancy. The certificates are to be final certificates giving complete clearance of the <i>Work</i>, in the event that such governmental authorities furnish such certificates.”</p>

SC51 GC 10.4 WORKERS’ COMPENSATION

SC51.1	10.4.1	<p><u>Delete</u> paragraph 10.4.1 and <u>replace</u> with the following:</p> <p>“10.4.1 Prior to commencing the <i>Work</i>, and with each and every application for payment thereafter, including the <i>Contractor’s</i> application for payment of the holdback amount following <i>Substantial Performance of the Work</i> and again with the <i>Contractor’s</i> application for final payment, the <i>Contractor</i> shall provide evidence of compliance with workers’ compensation legislation in force at the <i>Place of the Work</i>, including payments due thereunder.”</p>
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SC52 GC 11.1 INSURANCE

SC52.1	11.1	<p><u>Delete</u> entirety of GC 11.1 and <u>replace</u> with the following:</p> <p>“GC 11.1 INSURANCE</p> <p>11.1.1 Without restricting the generality of GC 12 – INDEMNIFICATION, the <i>Contractor</i> shall provide, maintain, and pay for the insurance coverages specified in GC 11.1 – INSURANCE. Unless otherwise stipulated, the duration of each insurance policy shall be from the date of commencement of the <i>Work</i> until the expiration of the warranty periods set out in the <i>Contract Documents</i>. Prior to commencement of the <i>Work</i> and upon the placement, renewal, <u>amendment</u>, or extension of all or any part of the insurance, the <i>Contractor</i> shall promptly provide the <i>Owner</i> with confirmation of coverage and, if required, a certified true copy of the policies certified by an authorized representative of the insurer together with copies of any <u>amending</u> endorsements.</p> <p>.1 General Liability Insurance</p> <p>General liability insurance shall be in the name of the <i>Contractor</i>, with the <i>Owner</i> and the <i>Consultant</i> named as <u>Additional</u> insureds, with limits of not less than \$2,000,000.00 inclusive per occurrence for bodily injury, death, and damage to property, including loss of use thereof, for itself and each of its employees, <i>Subcontractors</i> and/or agents. The insurance coverage shall not be less than the insurance required by IBC Form 2100, or its equivalent <u>replacement</u>, provided that IBC Form 2100 shall contain the latest edition of the relevant CCDC endorsement form. To achieve the desired limit, umbrella, or excess liability insurance may be used. All liability coverage shall be maintained for completed operations hazards from the date of <i>Substantial Performance of the Work</i>, as</p>
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set out in the certificate of *Substantial Performance of the Work*, on an ongoing basis for a period of 6 years following *Substantial Performance of the Work*. Where the *Contractor* maintains a single, blanket policy, the Addition of the *Owner* and the *Consultant* is limited to liability arising out of the *Project* and all operations necessary or incidental thereto. The policy shall be endorsed to provide the *Owner* with not less than 30 days' notice, in writing, in advance of any cancellation and of change or amendment restricting coverage.

.2 Automobile Liability Insurance

Automobile liability insurance in respect of licensed vehicles shall limits of not less than \$2,000,000.00 inclusive per occurrence for bodily injury, death and damage to property, covering all licensed vehicles *owned* or leased by the *Contractor*, and endorsed to provide the *Owner* with not less than 30 days' notice, in writing, in advance of any cancellation, change or amendment restricting coverage. Where the policy has been issued pursuant to a government-operated automobile insurance system, the *Contractor* shall provide the *Owner* with confirmation of automobile insurance coverage for all automobiles registered in the name of the *Contractor*.

.3 Aircraft and Watercraft Liability Insurance

Where determined necessary by the *Contractor*, acting reasonably, aircraft and watercraft liability insurance will be obtained in accordance with the provisions of paragraph 11.1.3. Aircraft and watercraft liability insurance with respect to owned or non-owned aircraft and watercraft if used directly or indirectly in the performance of the *Work*, including use of Additional premises, shall be subject to limits of not less than \$2,000,000.00 inclusive per occurrence for bodily injury, death and damage to property, including loss of use thereof and limits of not less than \$2,000,000.00 for aircraft passenger hazard. Such insurance shall be in a form acceptable to the *Owner*. The policies shall be endorsed to provide the *Owner* with not less than 30 days' notice, in writing, in advance of cancellation, change or amendment restricting coverage.

.4 Property and Boiler and Machinery Insurance

(1) Builder's Risk property insurance shall be in the name of the *Contractor* with the *Owner* and the *Consultant* named as Additional

		<p>insureds. The policy shall insure against all risks of direct physical loss or damage to the property insured which shall include all property included in the <i>Work</i>, whether owned by the <i>Contractor</i> or the owner or owned by others, so long as the property forms part of the <i>Work</i>. The property insured also includes all materials and supplies necessary to complete the work, whether installed in the work temporarily or permanently, in storage on the project site, or in transit to the project site, as well as temporary buildings, scaffolding, falsework forms, hoardings, excavation, site preparation and similar work. The insurance shall be for not less than the sum of the amount of the contract price and the full value of products that are specified to be provided by the owner for incorporation into the work, if applicable, with the deductible of \$10,000.00 payable by the contractor. The insurance shall include the foregoing and, otherwise, shall not be less than the insurance required by IBC Form 4042 or its equivalent <u>replacement</u> provided that the IBC Form 4042 shall include the latest <u>Addition</u> of the relevant CCDC endorsement form. The coverage shall be based on a completed value form and shall be maintained continuously until ten (10) days after the date of the final certificate of payment.</p> <p>(2) Boiler and machinery insurance shall be in the name of the <i>Contractor</i>, with the <i>Owner</i> and the <i>Consultant</i> named as <u>Additional</u> insureds, for not less than the <u>replacement</u> value of the boilers, pressure vessels and other insurable objects forming part of the <i>Work</i>. The insurance provided shall not be less than the insurance provided by the "Comprehensive Boiler and Machinery Form" and shall be maintained continuously from commencement of use or operation of the property insured and until 10 days after the date of the final certificate for payment.</p> <p>(3) The policies shall allow for partial or total use or occupancy of the <i>Work</i>.</p> <p>(4) The policies shall provide that, in the case of a loss or damage, payment shall be made to the <i>Owner</i> and the <i>Contractor</i> as their respective interests may appear. The <i>Contractor</i> shall act on behalf of the <i>Owner</i> for the purpose of adjusting the amount of such loss or damage payment with the insurers. When the extent of the loss or damage is determined, the <i>Contractor</i> shall proceed to restore the <i>Work</i>. Loss or damage shall not affect the rights and obligations of either party under the <i>Contract</i> except that the <i>Contractor</i> shall be entitled to such reasonable extension of the <i>Contract Time</i>, relative to the extent of the loss or damage, as determined by the <i>Owner</i>, in its sole discretion.</p>
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(5) The *Contractor* shall be entitled to receive from the *Owner*, in Addition to the amount due under the *Contract*, the amount at which the *Owner's* interest in restoration of the *Work* has been appraised, such amount to be paid as the restoration of the *Work* proceeds and as provided in GC 5.2 – APPLICATIONS FOR PROGRESS PAYMENT and GC 5.3 – PROGRESS PAYMENT. In Addition, the *Contractor* shall be entitled to receive from the payments made by the insurer the amount of the *Contractor's* interest in the restoration of the *Work*.

(6) In the case of loss or damage to the *Work* arising from the work of other contractors, or the *Owner's* own forces, the *Owner*, in accordance with the *Owner's* obligations under paragraph 3.2.2.4 of GC 3.2 – CONSTRUCTION BY OWNER OR OTHER CONTRACTORS, shall pay the *Contractor* the cost of restoring the *Work* as the restoration of the *Work* proceeds and as provided in GC 5.2 – APPLICATIONS FOR PROGRESS PAYMENT and GC 5.3 – PROGRESS PAYMENT.

.5 Contractors' Equipment Insurance

"All risks" contractors' equipment insurance covering construction machinery and equipment used by the *Contractor* for the performance of the *Work*, excluding boiler insurance, shall be in a form acceptable to the *Owner* and shall not allow subrogation claims by the insurer against the *Owner*. The policies shall be endorsed to provide the *Owner* with not less than 30 days' notice, in writing, in advance of cancellation, change or amendment restricting coverage. Subject to satisfactory proof of financial capability by the *Contractor* for self-insurance of his equipment, the *Owner* agrees to waive the equipment insurance requirement.

11.1.2 The *Contractor* shall be responsible for deductible amounts under the policies except where such amounts may be excluded from the *Contractor's* responsibility by the terms of GC 9.1 - PROTECTION OF WORK AND PROPERTY and GC 9.2 - DAMAGES AND MUTUAL RESPONSIBILITY.

11.1.3 Where the full insurable value of the *Work* is substantially less than the *Contract Price*, the *Owner* may reduce the amount of insurance required to waive the course of construction insurance requirement.

11.1.4 If the *Contractor* fails to provide or maintain insurance as required by the *Contract Documents*, then the *Owner* shall have the right to

		<p>provide and maintain such insurance and provide evidence of same to the <i>Contractor</i>. The <i>Contractor</i> shall pay the costs thereof to the <i>Owner</i> on demand, or the <i>Owner</i> may deduct the amount that is due or may become due to the <i>Contractor</i>.</p> <p>11.1.5 All required insurance policies shall be with insurers licensed to underwrite insurance in the jurisdiction of the <i>Place of the Work</i>.”</p>
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SC53 GC 11.2 CONTRACT SECURITY

SC53.1	11.2.1	<p><u>Delete</u> paragraph 11.2.1 and <u>replace</u> it with the following:</p> <p>“11.2.1 If required by the <i>Contract Documents</i>, the <i>Contractor</i> shall, prior to the execution of the <i>Contract</i> and within 7 calendar days of receiving <i>Notice in Writing</i> to do so, furnish a performance bond and labour and material payment bond which meets the requirements under paragraph 11.2.2.”</p>
SC53.2	11.2.2	<p><u>Delete</u> paragraph 11.2.2 and <u>replace</u> it with the following:</p> <p>“11.2.2 The performance bond and labour and material payment bond, if required, shall:</p> <ul style="list-style-type: none"> .1 be issued by a duly licensed surety company, which has been approved by the <i>Owner</i> and is permitted under the <i>Construction Act</i>, .2 be issued by an insurer licensed under the <i>Insurance Act</i> (Ontario) and authorized to transact a business of suretyship in the Province of Ontario; .3 shall be in the form prescribed by the <i>Act</i>; .4 have a coverage limit of at least 50 per cent of the <i>Contract Price</i>, or such other percentage of the <i>Contract Price</i> as stated in the <i>Contract Documents</i>; .5 extends protection to <i>Subcontractors</i>, <i>Suppliers</i>, and any other persons supplying labour or materials to the <i>Project</i>; and .4 shall be maintained in good standing until the fulfillment of the <i>Contract</i>, including all warranty and maintenance periods set out in the <i>Contract Documents</i>.”
SC53.3	11.2.3	<p><u>Add</u> new paragraph 11.2.3 as follows:</p>

		<p>“11.2.3 It is the intention of the parties that the performance bond shall be applicable to all of the <i>Contractor’s</i> obligations in the <i>Contract Document</i> and, wherever a performance bond is provided with language which conflicts with this intention, it shall be deemed to be amended to comply. The <i>Contractor</i> represents and warrants to the <i>Owner</i> that it has provided its surety with a copy of the <i>Contract Documents</i> prior to the issuance of such bonds.”</p>
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SC54 GC 12.1 INDEMNIFICATION

SC54.1	12.1	<p><u>Delete</u> GC 12.1 – INDEMNIFICATION in its entirety and <u>substitute</u> as follows:</p> <p>“12.1.1 The <i>Contractor</i> shall indemnify and hold harmless the <i>Owner</i>, its parent, subsidiaries and affiliates, their respective partners, trustees, officers, directors, agents and employees and the <i>Consultant</i> from and against any and all claims, liabilities, expenses, demands, losses, damages, actions, costs, suits, or proceedings (hereinafter called “claims”), whether in respect of claims suffered by the <i>Owner</i> or in respect of claims by third parties, that directly or indirectly arise out of, or are attributable to, the acts or omissions of the <i>Contractor</i>, its employees, agents, <i>Subcontractors</i>, <i>Suppliers</i> or any other persons for whom it is in law responsible (including, without limitation, claims that directly or indirectly arise out of, or are attributable to, loss of use or damage to the <i>Work</i>, the <i>Owner’s</i> property or equipment, the <i>Contractor’s</i> property or equipment or equipment or property adjacent to the <i>Place of the Work</i> or death or injury to the <i>Contractor’s</i> personnel).</p> <p>12.1.2 The provisions of GC 12.1 - INDEMNIFICATION shall survive the termination of the <i>Contract</i>, howsoever caused and no payment or partial payment, no issuance of a final certificate of payment and no occupancy in whole or in part of the <i>Work</i> shall constitute a waiver or release of any of the provisions of GC 12.1.”</p>
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SC55 GC 12.2 WAIVER OF CLAIMS

SC55.1	12.2.1	<p>In paragraph 12.2.1 in the fourth line after the word “limitation” <u>add</u> the words “claims for delay pursuant to GC 6.5 DELAYS”</p> <p>-and-</p> <p><u>add</u> the words “(collectively “Claims”)” after “<i>Substantial Performance of the Work</i>” in the sixth line.</p>
SC55.2	12.2.1.1	<p>In subparagraph 12.2.1.1 change the word “claims” to “Claims” and change the word “claim” to “Claim”.</p>
SC55.3	12.2.1.2	<p>In subparagraph 12.2.1.2 change the word “claims” to “Claims”.</p>
SC55.4	12.2.1.3	<p><u>Delete</u> subparagraph 12.2.1.3 in its entirety.</p>
SC55.5	12.2.1.4	<p>In paragraph 12.2.1.4 change the word “claims” to “Claims”.</p>

SC55.6	12.2.2	In paragraph 12.2.2 <u>delete</u> the words “in paragraphs 12.2.1.2 and 12.2.1.3” and <u>replace</u> them with “in paragraph 12.2.1.2” -and- change the word “claims” to “Claims” in both instances and change the word “claim” to “Claim”.
SC55.7	12.2.3	<u>Delete</u> paragraph 12.2.3 in its entirety.
SC55.8	12.2.4	<u>Delete</u> paragraph 12.2.4 in its entirety.
SC55.9	12.2.5	<u>Delete</u> paragraph 12.2.5 in its entirety.
SC55.10	12.2.6	In paragraph 12.2.6 change the word “claim” to “Claim” in all instances in the paragraph.
SC55.11	12.2.7	In paragraph 12.2.7 change “The party” to “The <i>Contractor</i> ” -and- change the word “claim” to “Claim” in all instances in the paragraph.
SC55.12	12.2.8	In paragraph 12.2.8 <u>delete</u> the words “under paragraphs 12.2.1 or 12.2.3” and <u>replace</u> them with “under paragraph 12.2.1” -and- change both instances of the words “the party” to “the <i>Contractor</i> ”. Change the word “claim” to “Claim” in all instances in the paragraph.
SC55.13	12.2.9	<u>Delete</u> paragraph 12.2.9 in its entirety.
SC55.14	12.2.1 0	<u>Delete</u> paragraph 12.2.10 in its entirety.

SC56 GC 12.3 WARRANTY

SC56.1	12.3.2	<u>Delete</u> from the first line of paragraph 12.3.2 the word, “The” and <u>substitute</u> with the words “Subject to paragraph 3.4.1, the...”
SC56.2	12.3.7 to 12.3.1 2	<u>Add</u> new paragraphs 12.3.7 to 12.3.12 as follows: “12.3.7 Where required by the <i>Contract Documents</i> , the <i>Contractor</i> shall provide a maintenance bond as security for the performance of the <i>Contractor’s</i> obligations as set out in GC 12.3 WARRANTY.”

	<p>12.3.8 The <i>Contractor</i> shall provide fully and properly completed and signed copies of all warranties and guarantees required by the <i>Contract Documents</i>, containing:</p> <ul style="list-style-type: none">.1 the proper name of the <i>Owner</i>;.2 the proper name and address of the <i>Project</i>;.3 the date the warranty commences, which shall be at the “date of <i>Substantial Performance of the Work</i>” unless otherwise agreed upon by the <i>Consultant</i> in writing..4 a clear definition of what is being warranted and/or guaranteed as required by the <i>Contract Documents</i>; and.5 the signature and seal (if required by the governing law of the <i>Contract</i>) of the company issuing the warranty, countersigned by the <i>Contractor</i>. <p>12.3.9 Should any <i>Work</i> be repaired or replaced during the time period for which it is covered by the specified warranty, a new warranty shall be provided under the same conditions and for the same period as specified herein before. The new warranty shall commence at the completion of the repair or replacement.</p> <p>12.3.10 The <i>Contractor</i> shall ensure that its <i>Subcontractors</i> are bound to the requirements of GC 12.3 – WARRANTY for the <i>Subcontractor’s</i> portion of the <i>Work</i>.</p> <p>12.3.11 The <i>Contractor</i> shall ensure that all warranties, guarantees or other obligations for <i>Work</i>, services or <i>Products</i> performed or supplied by any <i>Subcontractor</i>, <i>Supplier</i> or other person in connection with the <i>Work</i> are obtained and available for the direct benefit of the <i>Owner</i>. In the alternative, the <i>Contractor</i> shall assign to the <i>Owner</i> all warranties, guarantees or other obligations for <i>Work</i>, services or <i>Products</i> performed or supplied by any <i>Subcontractor</i>, <i>Supplier</i> or other person in connection with the <i>Work</i> and such assignment shall be with the consent of the assigning party, where required by law, or by the terms of that party’s contract. Such assignment shall be in addition to, and shall in no way limit, the warranty rights of the <i>Owner</i> under the <i>Contract Documents</i>.</p> <p>12.3.12 The <i>Contractor</i> shall commence or correct any deficiency within 2 <i>Working Days</i> after receiving a <i>Notice in Writing</i> from the <i>Owner</i> or the <i>Consultant</i>, and shall complete the <i>Work</i> as expeditiously as possible, except in the case where the deficiency prevents maintaining security or where basic systems essential to the ongoing business of the <i>Owner</i> and/or its tenants cannot be</p>
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		<p>maintained operational as designed. In those circumstances all necessary corrections and/or installations of temporary replacements shall be carried out immediately as an emergency service. Should the <i>Contractor</i> fail to provide this emergency service within 8 hours of a request being made during the normal business hours of the <i>Contractor</i>, the <i>Owner</i> is authorized, notwithstanding GC 3.1, to carry out all necessary repairs or replacements at the <i>Contractor's</i> expense.”</p>
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***NEW* PART 13 OTHER PROVISIONS**

SC57 GC 13.1 OWNERSHIP OF MATERIALS

SC57.1	13.1	<p><u>Add</u> new GC 13.1 – OWNERSHIP OF MATERIALS as follows:</p> <p>“GC 13.1 OWNERSHIP OF MATERIALS</p> <p>“13.1.1 Unless otherwise specified, all materials existing at the <i>Place of the Work</i> at the time of execution of the <i>Contract</i> shall remain the property of the <i>Owner</i>. All <i>Work</i> and <i>Products</i> delivered to the <i>Place of the Work</i> by the <i>Contractor</i> shall be the property of the <i>Owner</i>. The <i>Contractor</i> shall remove all surplus or rejected materials as its property when notified in writing to do so by the <i>Consultant</i>.”</p>
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SC58 GC 13.2 CONSTRUCTION LIENS

SC58.1	13.2	<p><u>Add</u> new GC 13.2 – CONSTRUCTION LIENS as follows:</p> <p>“GC 13.2 LIENS</p> <p>13.2.1 Notwithstanding any other provision in the <i>Contract</i>, the <i>Consultant</i> shall not be obligated to issue a certificate, and the <i>Owner</i> shall not be obligated to make payment, subject to the <i>Owner’s</i> requirement to issue a <i>Notice of Non-Payment</i> (Form 1.1) to the <i>Contractor</i>, if at the time such certificate or payment was otherwise due:</p> <ul style="list-style-type: none">.1 a claim for lien has been registered against the <i>Project</i> lands by a <i>Subcontractor</i> or a <i>Supplier</i> that has not been vacated or discharged by the <i>Contractor</i> in accordance with the requirements of this <i>Contract</i>, or.2 if the <i>Owner</i> or a mortgagee of the <i>Project</i> lands has received a written notice of a lien that has not been resolved by the <i>Contractor</i> through the posting of security or otherwise. <p>13.2.2 In the event a construction lien arising from the performance of the <i>Work</i> is registered or preserved against the <i>Project</i> lands by a <i>Subcontractor</i> or a <i>Supplier</i>, or a written notice of a lien is given or a construction lien action is commenced against the <i>Owner</i> by a <i>Subcontractor</i> or a <i>Supplier</i>, then the <i>Contractor</i> shall, at its own expense:</p> <ul style="list-style-type: none">.1 within 10 calendar days of registration of the construction lien, vacate or discharge the lien from title to the premises (i.e. the
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		<p><i>Place of the Work</i>). If the lien is merely vacated, the <i>Contractor</i> shall, if requested, undertake the <i>Owner's</i> defence of any subsequent action commenced in respect of the lien, at the <i>Contractor's</i> sole expense;</p> <p>.2 within 10 calendar days of receiving notice of a written notice of a lien, post security with the Ontario Superior Court of Justice so that the written notice of a lien no longer binds the parties upon whom it was served; and</p> <p>.3 satisfy all judgments and pay all costs arising from such construction liens and actions and fully indemnify the <i>Owner</i> against all costs and expenses arising from same, including legal costs on a full indemnity basis.</p> <p>13.2.3 In the event that the <i>Contractor</i> fails or refuses to comply with its obligations pursuant to paragraph 13.2.2, the <i>Owner</i> shall, at its option, be entitled to take all steps necessary to address any such construction liens including, without limitation and in addition to the <i>Owner's</i> rights under paragraph 13.2.4, the posting of security with the Ontario Superior Court of Justice to vacate the claim for lien from title to the <i>Project</i> lands, and in so doing will be entitled to a full indemnity from the <i>Contractor</i> for all legal fees, security, disbursements and other costs incurred and will be entitled to deduct same from amounts otherwise owing to the <i>Contractor</i>.</p> <p>13.2.4 In the event that any <i>Subcontractor</i> or <i>Supplier</i> registers any claim for lien with respect to all or part of the <i>Place of Work</i>, the <i>Owner</i> shall have the right to withhold, in addition to the statutory holdback, the full amount of said claim for lien plus either: (a) \$250,000 if the claim for lien is in excess of \$1,000,000 or (b) 25% of the value of the claim for lien and to bring a motion to vacate the registration of said claim for lien and any associated certificate of action in respect of that lien, in accordance with Section 44 of the <i>Act</i>, by paying into court as security the amount withheld.</p> <p>13.2.5 Nothing in this GC 13.2 serves to preclude the <i>Contractor</i> from preserving and perfecting its lien in the event of non-payment by the <i>Owner</i>."</p>
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APPENDIX 1
to the Supplementary Conditions

Project-specific requirements for a “*Proper Invoice*”

To satisfy the requirements for a *Proper Invoice*, the following criteria, as may be applicable in each case, must be included with the *Contractor’s* application for payment:

- .1 the written bill or request for payment must be in writing;
- .2 the *Contractor’s* name and current address;
- .3 the *Contractor’s* HST registration number;
- .4 the date the application for payment was prepared by the *Contractor*;
- .5 the period of time in which the services or materials were supplied to the *Owner*;
- .6 the purchase order number provided by the *Owner*;
- .7 reference to the provisions of the *Contract* under which payment is being sought (e.g. GC 5.3 – PROGRESS PAYMENTS for progress payments, GC 5.4 – SUBSTANTIAL PERFORMANCE OF THE WORK, GC 5.7 – FINAL PAYMENT for final payment, etc.);
- .8 a description, including quantities where appropriate, of the services or materials, or a portion thereof, that were supplied and form the basis of the *Contractor’s* request for payment;
- .9 the amount the *Contractor* is requesting to be paid by the *Owner*, set out in a statement based on the schedule of values approved under GC 5.2.5, separating out any statutory or other holdbacks, set-offs and HST;
- .10 a sworn Statutory Declaration in the form CCDC 9A-2018, only for second and subsequent progress payments;
- .11 a current Workplace Safety Insurance Board clearance certificate;
- .12 a pre-approved schedule of values, supplied by the *Contractor*, for Divisions 1 through 14 of the *Specifications* (or equivalent Construction Specifications Institute Masterformat) of the *Work*, aggregating the total amount of the *Contract Price*, including all supporting invoicing;
- .13 a separate pre-approved schedule of values, supplied by each *Subcontractor*, for each of Division 15, 16, and 17 of the *Specifications* (or equivalent Construction

- Specifications Institute Masterformat) of the *Work*, aggregating the total amount of the *Contract Price*, including all supporting invoicing;
- .14 invoices and other supporting documentation for all claims against the cash allowance;
 - .15 a current, acceptable, and up to date *Construction Schedule Update*;
 - .16 if requested by the *Owner*, a current and valid certificate(s) of insurance as required under GC 11.1 – INSURANCE;
 - .17 the name, title, telephone number and mailing address of the person at the place of business of the *Contractor* to whom payment is to be directed;
 - .18 a current, up to date, and approved *Shop Drawing* log;
 - .19 in the case of the *Contractor's* application for final payment, in addition to the foregoing requirements (as applicable):
 - (a) any documents or materials not yet delivered pursuant to paragraph 5.4.5, together with complete and final as-built drawings;
 - (b) the *Contractor's* written request for release of the deficiency holdback, including a statement that no written notices of lien have been received by it;
 - (c) the *Contractor's* written certification that there are no outstanding claims, pending claims or future claims from the *Contractor* or their *Subcontractors* or *Suppliers*; and
 - (d) sufficient evidence of the *Contractor's* compliance with GC 3.13.3.

END OF AMENDMENTS TO CCDC 2 - 2008

SECTION 01 14 00 – WORK RESTRICTIONS

1.0 GENERAL

1.1. SECTION INCLUDES

- .1 Connecting to existing services
- .2 Special scheduling requirements

1.2. RELATED SECTIONS

- .1 Section 01 53 00 - Temporary Construction.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3. EXISTING SERVICES

- .1 Notify Owner and Consultant and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Consultant and Owner, forty-eight (48) hours of notice for necessary interruption of mechanical or electrical service throughout course of work.
 - .1 Keep duration of interruptions minimum.
 - .2 Perform interruptions after normal working hours of occupants, preferably on weekends.
- .3 Provide for vehicular, pedestrian and personnel traffic.
- .4 Construct barriers in accordance with Section 01 53 00.

1.4. AFTER HOURS WORK

- .1 Schedule Work with school staff through the Board's contact so as to limit disruption to school operations. Include for any overtime, to ensure orderly and continuous progression of Work and operation of school.
- .2 Direct calls from Contractors to Board staff to adjust alarms and to arrange for access will not be accepted. All correspondence must be through the Project Manager.
- .3 Arrange 48 hours in advance with Board to obtain an access card and adjust security alarms for after hours Work.
- .4 Bidders are cautioned that the Board will be compensated by the Contractor for false alarms. Any costs associated with each false alarm will be levied against the Contractor for false fire alarm activation or security alarm activation. These costs may include, but are not limited to:

- .1 Fines or penalties imposed by the local Fire Services,
- .2 Fines or penalties imposed by the local Police Services,
- .3 Overtime costs borne by the Board.
- .5 Contractors are responsible for ensuring doors and windows are secured prior to leaving school.
- .6 Unless specifically stated otherwise school activities take precedence over Contractor's activities.

1.5. SPECIAL REQUIREMENTS

- .1 Schedule and perform work in occupied areas to Board Representative's approval.
- .2 Schedule and perform noise generating work to Board Representative's approval.
- .3 Submit schedule of special requirements or disruptions in accordance with Section 01 33 00.
- .4 All Contractor personnel are restricted to the job site and necessary access routes. No personnel shall visit other areas or buildings without specific authorization.

END OF SECTION

SECTION 01 19 00 – SPECIFICATIONS AND DOCUMENTS

1.0 GENERAL

1.1. RELATED DOCUMENTS

- .1 This section describes requirements applicable to all sections within Divisions 02 to 49.

1.2. WORDS AND TERMS

- .1 Conform to definitions and their defined meanings in the Agreement and Definitions portion of CCDC 2 for Supplementary Words and Terms listed in Section 00 56 13.

1.3. COMPLEMENTARY DOCUMENTS

- .1 Generally, drawings indicate graphically, the dimensions and location of components and equipment. Specifications indicate specific components, assemblies, and identify quality.
- .2 Drawings, specifications, diagrams and schedules are complementary, each to the other, and what is required by one, to be binding as if required by all.
- .3 Should any conflict or discrepancy appear between documents, which leaves doubt as to the intent or meaning, apply the Precedence of Documents article below or obtain guidance or direction from Consultant.
- .4 Examine all discipline drawings, specifications, schedules, diagrams and related Work to ensure that Work can be satisfactorily executed.
- .5 All specification sections of the Project Manual and Drawings are affected by requirements of Division 01 sections.

1.4. PRECEDENCE OF DOCUMENTS

- .1 In the event of conflict within and between the Contract Documents, the order of priority within specifications and drawings for this project are - from highest to lowest:
 - .1 the Agreement and Definitions between the Owner and the Construction
 - .2 the Defined Terms, Definitions;
 - .3 Supplementary Conditions;
 - .4 the General Conditions;
 - .5 Sections of Division 01 of the specifications;
 - .6 Technical specifications Sections of Divisions 02 through 49 of the specifications.

- .7 Schedules and Keynotes:
 - .1 Material and finishing schedules within the specifications, then;
 - .2 Material and finishing schedules on drawings, then;
 - .3 Keynotes and definitions thereto, then;
- .8 Drawings:
 - .1 Drawings of larger scale shall govern over those of smaller scale of the same date, then;
 - .2 Dimensions shown on drawings shall govern over dimensions scaled from drawings, then;
 - .3 Location of utility outlets indicated on architectural detail drawings takes precedence over positions or mounting heights located on mechanical or electrical Drawings.
- .9 Later dated documents shall govern over earlier documents of the same type.

1.5. SPECIFICATION GRAMMAR

- .1 Specifications are written in the imperative command mode, in an abbreviated form.
- .2 Imperative language of the technical sections is always directed to the Contractor identified as a primary constructor, as sole executor of the Contract, unless specifically noted otherwise.
 - .1 This form of imperative command mode statement requires the primary constructor to perform such action or Work.
 - .2 Perform all requirements of the Contract Documents whether stated imperatively or otherwise.
- .3 Division of the Work among subcontractors, suppliers, or others is solely the prime constructor's responsibility. The Consultant(s) and specification authors assume no responsibility to function or act as an arbiter to establish subcontract scope or limits between sections or divisions of Work.

END OF SECTION

SECTION 01 21 00 – ALLOWANCES

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 45 00 – Quality Control.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. GENERAL

- .1 Allowances included herein are for items of Work which could not be fully quantified prior to Bidding.
- .2 Expend each allowance as directed by the Consultant. Work covered by allowances shall be performed for such amounts and by such persons as directed by Consultant.
- .3 Funds will be expended by means of Cash Allowance allocations and contingency allowance allocations.
- .4 Progress payments for Work and Products authorized under allowances will be made in accordance with the payment terms set out in the Conditions of the Contract.
- .5 The Contractor shall bid the work involved and submit the Bids received to the Consultant and the Board, for approval
- .6 The Contractor shall submit 3 bids unless directed by the Board.

1.3. CASH ALLOWANCES

- .1 Cash allowances, cover the net cost to the Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation where indicated, and other authorized expenses incurred in performing the Work. Cash allowances shall not be included by a subcontractor in the amount for their subcontract work.
- .2 Supply only allowances shall include:
 - .1 Net cost of Products.
 - .2 Delivery to Site.
 - .3 Applicable taxes and duties, excluding HST.
- .3 Supply and install allowances shall include:
 - .1 Net cost of Products.
 - .2 Delivery to Site.
 - .3 Unloading, storing, handling or products on site.
 - .4 Installation, finishing and commissioning of products.

- .5 Applicable taxes and duties, excluding HST.
- .4 Inspection and testing allowances shall include:
 - .1 Net cost of inspection and testing services.
 - .2 Applicable taxes and duties, excluding HST.
- .5 Other costs related to work covered by cash allowances are not covered by the allowance, but shall be included in the Contract Price.
- .6 Where costs under a cash allowance exceed the amount of the allowance, the Contractor will be compensated for any excess incurred and substantiated plus an allowance for overhead and profit as set out in the Contract Documents.
- .7 Progress payments on accounts of work authorized under cash allowances shall be included in the monthly certificate for payment.
- .8 Submit, before application for final payment, copies of all invoices and statements from suppliers and subcontractors for work which has been paid from cash allowances.

1.4. ALLOWANCES SCHEDULE

Include in the Bid Price a cash allowance of to address the cost of the following items: (Consultant to modify/edit list as required)

- .1 Designated Substance Removal. \$10,000.00
(Additional removal not already identified in the ACM Summary report)

- .2 Independent Testing and Inspection (soil, concrete, mortar, structural steel, air barrier, paving, painting) \$ 10,000.00
(As directed by the Consultant, independent testing and inspection not already identified in this specification as part of the base contract)

- .3 Window coverings \$ 10,000.00
(Additional window coverings not addressed elsewhere in the specification)

- Finished Hardware. \$ 45,000.00
(Including all supply and hardware installation)

- Total of All Allowances:** **\$75,000.00**

END OF SECTION

SECTION 01 31 00 – PROJECT MANAGING AND COORDINATION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 32 00 - Construction Progress Documentation.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 53 00 – Temporary Construction Facilities
- .4 Section 01 61 00 – Product Requirements
- .5 Section 01 78 10 – Closeout Submittals and Requirements
- .6 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. PROJECT COORDINATION

- .1 Perform coordination of progress schedules, submittals, use of site, temporary utilities, construction facilities and construction Work, with progress of Work of other contractors, under instructions of the Consultant.
- .2 The Contractor shall have total control of the Work and shall effectively direct and supervise the Work so as to ensure conformity with the Contract Documents and within the Contract Time.
- .3 The Contractor shall be solely responsible for the construction means, methods, sequences, and procedures and for coordinating parts of the Work under the contract.
- .4 Co-ordinate progress of the Work, progress schedules, submittals, use of site, temporary utilities, construction facilities, safety regulations and fire protection, as per authorities having jurisdiction codes.
- .5 The Consultant has the authority to stop the Work:
 - .1 whenever they observe or are made aware of unsafe conditions.
 - .2 whenever it is deemed necessary to protect the interests of the Board,
 - .3 whenever materials or workmanship are in contravention to the Contract Documents

1.3. SITE SUPERVISOR AND PROJECT MANAGER

- .1 If requested, the Contractor shall provide the Consultant, in writing, the name of the Project Manager and Site Supervisor, and proof of competent experience in similar projects.
- .2 Performance of the Contractors Project Manager and Site Supervisor
 - .1 If the Board and or the Consultant become concerned with any of: Site Safety, Project Schedule, or general compliance with the tender

- documents due to the performance of the Site Supervisor or Project Manager, the Consultant and or the Board will identify the concerns in writing to the Contractor.
- .2 The Contractor shall respond in writing to the Board and Consultant with a corrective action for each item within 24 hours.
 - .3 If it is found that any of the corrections are not immediately implemented, the Consultant and the Board shall meet with the General Contractor to review the credentials including curriculum vitae and comparable experience of a replacement Site Supervisor and or Project Manager proposed by that Contractor.
 - .4 All outstanding concerns initiating the replacement of the personnel will be immediately addressed to the satisfaction of the Consultant and the Board.
- .3 If the Board and or the Consultant become concerned with site safety, project schedule or general compliance with the tender documents due to the performance of the Site Supervisor or the Project Manager, the Consultant or the Board will issue the concerns in writing to the Contractor. The Contractor shall respond in writing within 24 hours to the Consultant and the Board. If any of the corrections are not immediately implemented, the Consultant or the Board will schedule a meeting with the Consultant, General Contractor and the Board. At this meeting the Contractor will introduce the new Project Manager, and or Site Supervisor and present the Curriculum Vitae for each showing proof of comparable experience in similar projects. The Contractor will then address the outstanding concerns to the satisfaction of the Consultant and the Board.
- .4 The Project Manager, and/or Site Supervisor shall not be replaced by the Contractor without prior written approval from the Board and the Consultant.

1.4. PERMITS

- .1 **The Board will obtain & pay for all building permits, but the Contractor is responsible for all other permits, including electrical inspection and fire alarm verification.**

1.5. CONSTRUCTION DOCUMENTS

- .1 The Consultant will provide the Contractor with PDF copies of both the drawings and the specification and CAD format files of the drawings at no charge to the Contractor. All printing will be at the cost of the Contractor including the AS-BUILT documents.

1.6. PRECONSTRUCTION MEETING

- .1 Immediately prior to construction and upon notification by the Consultant of a time and date, the Contractor shall attend the preconstruction meeting at a location as determined by the Consultant, along with authoritative representatives of certain key subcontractors as specifically indicated in the conference notice. Agenda to include following:
 - .1 Appointment of official representative of participants in Work.
 - .2 Project communications procedures
 - .3 Schedule of Work, progress scheduling (including long lead items, cash allowance items) as specified in Section 01 32 00.
 - .4 Schedule of submission of shop drawings, samples, colour chips as specified in Section 01 33 00.
 - .5 Requirements for temporary facilities, washrooms, refuse bin, site sign, offices, storage sheds, utilities, fences as specified in Section 01 53 00.
 - .6 Delivery schedule of specified equipment as specified in Section 01 61 00.
 - .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, and administrative requirements.
 - .8 Owner furnished products.
 - .9 Record drawings as specified in Section 01 78 10.
 - .10 Maintenance material and data as specified in Section 01 78 10.
 - .11 Take-over procedures, acceptance, and warranties as specified in Section 01 78 10.
 - .12 Monthly progress claims, administrative procedures, photographs, and holdbacks.
 - .13 Appointment of inspection and testing agencies
 - .14 Insurances and transcript of policies.
 - .15 Review Vendor Performance Evaluation for the Contractor and Subcontractors
 - .16 Hot Work Permit Process
 - .17 Security Access, Fire Alarm shut down procedures
 - .18 Any other items as required by owner, contractor or Consultant.

1.7. ON-SITE DOCUMENTS

- .1 Maintain at job site at all times, one copy (written or digital) each of the following:
 - .1 Complete set of Contract drawings.

- .2 Specifications.
- .3 All Addenda.
- .4 Site Instructions and Sketches
- .5 Reviewed shop drawings and samples.
- .6 Change Orders and Contemplated Change Orders.
- .7 Other modifications to Contract.
- .8 Site Instructions
- .9 Colour schedule
- .10 Hardware List
- .11 Field test reports.
- .12 Copy of approved Work schedule.
- .13 Manufacturers' installation and application instructions.
- .14 Progress reports and meeting minutes.
- .15 Approved building permit documents.
- .16 Copy of current Ontario Building Code and National Building Code.
- .17 CSA Standard, CGSB Specifications. ASTM Documents and other standards referenced to in the specifications.
- .18 Labour conditions and wage schedules.
- .19 Applicable current editions of municipal regulations and by-laws. Current building codes, complete with addenda bulletins applicable to the Place of the Work.

1.8. SCHEDULES

- .1 Within three weeks following the award of the Contract, submit a detailed, trade by trade progress schedule for the work in a bar chart form acceptable to the Consultant.
- .2 Submit preliminary construction progress schedule as specified in Section 01 32 00 to Consultant coordinated with Consultant's project schedule.
- .3 After review, revise and resubmit schedule to comply with revised project schedule.
- .4 During progress of Work revise and resubmit as directed by Consultant.
- .5 Provide schedule updates every month with request for Payment, for duration of Contract.

1.9. CONSTRUCTION PROGRESS MEETINGS

- .1 Prior to the commencement of the Work, the Contractor together with the Consultant shall mutually agree to a sequence for holding regular "on site meetings".

- .2 The Contractor will organize site meetings. Ensure persons, whose presence is required, are present and relative information is available to allow meetings to be conducted efficiently.
- .3 Contractor, major subcontractors and consultants involved in Work are to be in attendance.
- .4 Post and forward copies of progress schedules for advice of Subcontractors, Owner and Consultant.
- .5 Notify parties minimum five (5) days prior to meetings.
- .6 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within two (2) days after meeting.
- .7 Agenda to include following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for effect on construction schedule and on completion date.
 - .12 Review site security issues.
 - .13 Other business.
- .8 Schedule additional meetings, to expedite progress, should work require it.
- .9 Keep Owner and Consultant informed of progress, of delays and potential delays during all stages of Work. Do everything possible to meet progress schedule
- .10 Schedule and administer pre-installation meetings when specified in sections and when required to coordinate related or affected Work.

1.10. SUBMITTALS

- .1 Prepare and issue submittals to Consultant for review.
- .2 Submit preliminary Shop Drawings, product data and samples for review for compliance with Contract Documents; for field dimensions and clearances, for relation to available space, and for relation to Work of other contracts. After review, revise and resubmit for transmittal to Consultant.
- .3 Submit requests for payment for review, and for transmittal to Consultant.

- .4 Submit requests for interpretation of Contract Documents, and obtain instructions through Consultant.
- .5 Process substitutions through Consultant.
- .6 Process change orders through Consultant.
- .7 Deliver closeout submittals for review and preliminary inspections, for transmittal to Consultant.

1.11. RECORD (AS-BUILT) DOCUMENTS AND SAMPLES

- .1 Procedures for record as-built documents and samples as specified in Section 01 78 10.
- .2 Keep as-built documents and samples available for inspection by Consultant.

1.12. CLOSEOUT PROCEDURES

- .1 Take-over procedures, acceptance, and warranties as specified Section 01 78 10
- .2 Notify Consultant and Board when Work is considered ready for Substantial Performance.
- .3 Accompany Consultant and Board on preliminary inspection to determine items listed for completion or correction.
- .4 Comply with Consultant's instructions for correction of items of Work listed in executed certificate of Substantial Performance.
- .5 Notify Consultant of instructions for completion of items of Work determined in Consultant's final inspection.

END OF SECTION

SECTION 01 32 00 – CONSTRUCTION PROGRESS DOCUMENTATION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. SCHEDULES

- .1 Within seven 7 days following the award of the Contract, submit a detailed cash flow chart broken down on a monthly basis, in a manner acceptable to the Consultant. Cash flow chart shall indicate anticipated Contractor's monthly progress billings from commencement of work until completion.
- .2 Update cash flow chart whenever changes occur to scheduling and in manner and at times satisfactory to Consultant.
- .3 Submit schedule of values at least fourteen (14) days before the first application
- .4 Submit schedules as follows:
 - .1 Submittal Schedule for Shop Drawings and Product Data.
 - .2 Submittal Schedule for Samples.
 - .3 Submittal Schedule for timeliness of Owner-furnished Products.
 - .4 Product Delivery Schedule.
 - .5 Cash Allowance Schedule for acquiring Products and Installation.
 - .6 Shutdown or closure activity.

1.3. CONSTRUCTION PROGRESS SCHEDULING

- .1 Submit initial schedule to the Consultant and the Board in duplicate within seven (7) days after following the award.
- .2 Schedule Format.
 - .1 Prepare schedule in form of a horizontal bar chart.
 - .2 Split horizontally for projected and actual performance.
 - .3 Provide horizontal time scale identifying each Working Day of each week.
- .3 Schedule Submission.
 - .1 Consultant will review schedule and return reviewed copies within five (5) days after receipt.
 - .2 Submit schedules in electronic format, forward to the Consultant and Owner as a pdf. file.

- .3 Resubmit finalized schedule within five (5) days after return of review copy.
- .4 Submit revised progress schedule with each application for payment.
- .5 Distribute copies of revised schedule to:
 - .1 Job site office.
 - .2 Subcontractors.
 - .3 Other concerned parties.
- .6 Instruct Consultant to report to Contractor within ten (10) days, any problems anticipated by timetable shown in schedule.
- .4 Submit revised schedules with Application for Payment, identifying changes since previous version.
- .5 Select either of the following paragraphs to identify the type and format of schedule required.
- .6 Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- .7 Indicate estimated percentage of completion for each item of Work at each submission.
- .8 Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates, including those furnished by Owner and required by Allowances.
- .9 Include dates for commencement and completion of each major element of construction:
 - .1 Site clearing.
 - .2 Site utilities.
 - .3 Foundation Work.
 - .4 Structural framing.
 - .5 Subcontractor Work.
 - .6 Equipment Installations.
 - .7 Finishes.
- .10 Indicate projected percentage of completion of each item as of first day of month.
- .11 Indicate progress of each activity to date of submission schedule.
- .12 Indicate changes occurring since previous submission of schedule:
 - .1 Major changes in scope.
 - .2 Activities modified since previous submission.
 - .3 Revised projections of progress and completion.
 - .4 Other identifiable changes.
- .13 Provide a written report to define:

- .1 Problem areas, anticipated delays, and impact on schedule.
- .2 Corrective action recommended and its effect.
- .3 Effect of changes on schedules of other subcontractors.

1.4. PROGRESS PHOTOGRAPHS

- .1 Digital Photography:
 - .1 Submit electronic copy of progress photographs of project, Digital format, minimum 300 in megapixel resolution.
 - .2 Identification: Name and number of project and date of exposure indicated.
 - .3 Provide both interior and exterior photographs.
 - .4 Number of Viewpoints: Locations of viewpoints determined by Consultant.
 - .5 Frequency: Monthly with progress statement. Provide the required number of pictures to accurately reflect the submitted progress percentage.

1.5. SHOP DRAWING SUBMITTAL SCHEDULE

- .1 Include schedule for submitting shop drawings, product data, samples
- .2 Indicate dates for submitting, review time, resubmission time, and last date for meeting fabrication schedule.
- .3 Include dates when shop drawings and samples will be required for Owner-furnished products.
- .4 Include dates when reviewed submittals will be required from Consultant.
- .5 Provide final signed off copies of the shop drawings in digital format to the Board.

END OF SECTION

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SECTION 01 33 00 – SUBMITTAL PROCEDURES

2.0 GENERAL

2.1. RELATED SECTIONS

- .1 Section 01 32 00 - Construction Progress Documentation.
- .2 Section 01 78 10 - Closeout Submittals.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

2.2. ADMINISTRATIVE

- .1 Submit to 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.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Present Shop Drawings, product data, samples and mock-ups in Metric (SI) units. Shop drawings containing imperial measurements will be rejected.
- .4 Where items or information is not manufactured or produced in SI Metric units, converted values within the metric measurement to the next largest imperial size available. Tolerances of .0625 acceptable.
- .5 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents.
- .6 Submittals not stamped, signed, dated, identified as to specific project, and attesting to their being reviewed will be returned without being examined and shall be considered rejected.
- .7 Shop drawings which require the approval of a legally constituted authority having jurisdiction shall be submitted by Contractor to such authority for approval. Such shop drawings shall receive final approval of authority having jurisdiction before Consultant's final review.
- .8 No work, requiring a shop drawing submission, shall be commenced until the submission has received Consultant's final review. Only shop drawings bearing Consultant's review stamp are to be sent and used on the job site.
- .9 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

- .10 Shop drawings shall not contain substituted materials unless such substitutions have been requested in advance and approved by Consultant.
- .11 Verify field measurements and affected adjacent Work are coordinated.
- .12 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- .13 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.
- .14 Keep one (1) reviewed copy of each submission on site.

2.3. SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "Shop Drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 The term "design team" means Consultant and Sub-consultants whether Sub-consultants are employees of Consultant or not, and includes structural, mechanical, electrical, etc.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow fourteen (14) days for Consultant's review of each submission.
- .5 Adjustments made on Shop Drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .6 Make changes in Shop Drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of any revisions other than those requested.
- .7 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .8 Submissions shall include:
 - .1 Date and revision dates.

- .2 Project title and number.
- .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to other parts of the Work.
- .9 After Consultant's review, distribute copies.
- .10 Submit Shop Drawings in Pdf. format for each requirement requested in specification Sections and as consultant may reasonably request.
- .11 Submit product data sheets or brochures in Pdf. format for requirements requested in specification sections and as requested by Consultant where Shop Drawings will not be prepared due to standardized manufacture of product.
- .12 Delete information not applicable to project.
- .13 Supplement standard information to provide details applicable to project.
- .14 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, the drawings will be stamped as reviewed or reviewed as modified and will be returned. At this point fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and re-submission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .15 Signed drawings shall be returned to and retained by Contractor who is then responsible for distribution of copies of corrected shop drawing to

appropriate Subcontractors for appropriate action and to municipal building department for their records of those subjects required by authorities.

- .16 The Consultant's review is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and this review shall not relieve the Contractor of his responsibility for meeting the 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 subtrades.

2.4. SAMPLES

- .1 Submit for review to the Consultant three (3) samples as requested in respective specification Sections.
- .2 Submit samples with identifying labels bearing material or component description, manufacturer's name and brand name, Contractor's name, project name, location in which material or component is to be used, and date.
- .3 Deliver samples prepay any shipping charges involved for delivering samples to destination point and returning to point of origin if required.
- .4 Provide samples of special products, assemblies, or components when so specified.
- .5 No work requiring a sample submission shall commence until submission has received Consultant's final review.
- .6 Notify Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .7 Where colour, pattern or texture is criterion, submit full range of samples.
- .8 Adjustments made on samples by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .9 Make changes in samples which Consultant may require, consistent with Contract Documents.
- .10 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

2.5. MOCK-UP

- .1 Erect mock-ups to Section 01 45 00.

2.6. CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, and prior to commencing the work submit the performance bond and the labour and materials payment bond as described in the bid documents.
- .2 Submit transcription of certified true copies of insurance immediately after award of Contract.
- .3 A current WSIB clearance certificate
- .4 The bidder's health and safety policy for the project.
- .5 A copy of the notice of project issued by the ministry of labour for the project
- .6 Building materials, components and elements specified without the use of trade or proprietary names shall meet requirements specified. If requested by Consultant, submit evidence of meeting requirements specified. Evidence shall consist of certification based on tests carried out by an independent testing agency. Certification based on previous tests for same materials, components or elements is acceptable. Certification shall be in form of written test reports prepared by testing agency.

END OF SECTION

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SECTION 01 35 17 – FIRE SAFETY PROCEDURES

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 14 00 – Work Restrictions.
- .2 Section 01 31 00 - Project Managing and Coordination.
- .3 Section 01 33 00 - Submittal Procedures.
- .4 Section 01 35 23 – Health and Safety
- .5 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. FIRE SAFETY PLAN

- .1 Contractors and their personnel will be familiar with this section and its requirements.
- .2 The contractor must take all necessary precautions during the carrying out of the work to prevent the possibility of fire occurring.

1.3. FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by the governing codes, regulations and bylaws.
- .2 The contractor will, at all times, when welding, brazing and performing any operation with an open flame, combustible adhesives or flammable solvents keep a portable, operable fire extinguisher within 3 meters of the operation.

1.4. HOT WORK

- .1 Take all precautions to Work safely and to provide the necessary protection to persons and property from Hot Work. This includes, but is not limited to Brazing, Cutting, Grinding, Soldering, Thawing Pipe, Torch Applied Roofing and Welding. With all such activity these steps are to be followed:
 - .1 Whenever possible, complete Hot Work in a welding shop or out of doors at the school.
 - .2 Flammable liquids, dust lint and oily deposits to be removed from within 50-ft (15m) of Work. Remove other combustibles where possible. Otherwise protect with fire-resistive tarpaulins or metal shields.
 - .3 Explosive atmosphere in area eliminated. Floors swept clean. Combustible floors wet down, covered with damp sand or fire-resistive tarpaulins.

- .4 All wall and floor openings covered. Fire-resistive tarpaulins suspended beneath Work.
- .5 For on-site Work (indoor and out of doors), advise the Head Custodian, Principal, Consultant (if assigned) and Project Coordinator prior to Work being performed, and of related dangers.
- .6 Where the Fire Alarm system is required to be set to stand-by to discourage false alarms from smoke detectors provide a firewatch throughout the building or structure being worked on. NEVER put the fire alarm system in stand-by mode when the building is occupied by staff or students.
- .7 In the event of a fire as a result of the Hot Work, notify the fire department immediately. Report incident to the head custodian, the Consultant, if assigned, and Project Coordinator immediately, whether extinguished or not. Provide a fire incident report to the Board.
- .8 Barriers must be set up to protect staff and students (i.e. pylons, shields, and caution tape) from exposure to arc flash and smoke migration.
- .9 Have all necessary doors, windows and/or drapes closed. Confer with the Head Custodian to shut down all fan systems in the area to reduce or eliminate smoke distribution.
- .10 Provide and keep fire extinguishers handy and in good Working condition. Temporarily cover all smoke detectors in area during time of Work.
- .11 Provide a fire watch/spot check for several hours after Work is completed. Uncover smoke detectors.
- .12 On new construction, the requirements of the Hot Work permit may be waived, until such time as either Substantial Completion or Occupancy is granted, whichever comes first.
- .13 On additions to existing buildings, the requirements for Hot Work permits shall remain in place.

1.5. HOT WORK PERMIT

- .1 **A sample Hot Work Permit is attached to the specifications – refer to Appendix 013517-A**
- .2 Each permit is valid for seven (7) days only and must be renewed prior to its expiration date
- .3 The contractor must obtain Hot Work Permits from the School Board's representative prior to the start of work.

- .4 The contractor must complete the form as required and must keep the form on site.
- .5 Return each completed form to the School Board's representative on date of expiration.
- .6 The most current version of the Permit and it's requirements shall be used for the purposes of the Work.

1.6. FIRE PROTECTION SYSTEMS

- .1 Any Modifications to Fire Alarm system and it's devices including service, additions and changes in device location must be performed only by a Certified Fire Alarm Technician as per the Ontario Fire Code section 1.1, subsection 1.1.5.
- .2 The Contractor will receive from the Board's contact a contact number for the monitoring service and a school system number.
- .3 Bidders are cautioned that the Board will be reimbursed for the cost of false alarms. Refer to Section 01 14 00 Work Restrictions, Para. 1.4.4.
- .4 An approved inspection firm shall verify all new fire alarm devices, in accordance to CSA regulations. Certificate of Verification is required before occupancy.

1.7. FIRE ALARM SHUT-DOWN PROCEDURE

- .1 Do not shut the system down unless necessary. Plan the operation required to reduce system down time to the least amount possible.
- .2 Wherever possible, shut down only the zone needing Work and schedule this down time in unoccupied school hours. Allow for this in your bid pricing.
- .3 Discuss the possible down time with the head custodian and principal prior to any partial or whole system shut down.
- .4 The school or building administration shall advise all staff of fire alarm system shut down. This will include instructions to call 911 if they see a fire and when system is back on line.
- .5 Prior to alarm system shutdown and upon restoring the fire alarm system individuals supervising the shut down must contact Direct Detect at 519-741-2494 and have on hand the School System Account Number (this number can be found on the decal on the fire alarm panel). The School System Account Number will start with the prefix 209
 - .1 The Contractor shall provide full detail to the monitoring company as requested including building number and name (as identified on the fire alarm monitoring panel), contact name, company name, length of time system is down. Call shall be placed just prior to any shut down.

- .6 A fire patrol will need to be established and will include the following at the Contractor's expense:
 - .1 Patrol all halls and high-risk areas affected.
 - .2 Fire patrol shall have access to a phone and call 911 if they see a fire.
 - .3 Report all other problems they encounter.
 - .4 Remain on patrol until system is back on.
- .7 Contact Direct Detect at 519-741-2494 and inform them when the system is put back on line.
- .8 An activated system must not be reset until authorized by the Fire Department and the cause of the alarm has been investigated.

1.8. FIRE PROTECTION EQUIPMENT IMPAIRMENT

- .1 Fire Protection Equipment referred to in this section includes sprinkler systems, special fire suppression systems, and kitchen hood suppression systems.
- .2 The Contractor will take all precautions including restrict all Hot Work operations and shut down hazardous processes during all Fire protection equipment impairment.
- .3 Do not shut the Fire protection equipment down unless necessary Plan the operation required to reduce system impairment time to the least amount possible.
- .4 Wherever possible, shut down only the Fire protection equipment needing Work and schedule this impairment time for unoccupied school hours. Allow for this in your bid pricing.
- .5 Discuss the possible down time with the head custodian and principal prior to any partial or whole system impairment.
- .6 The school administration shall advise all staff of Fire protection equipment shut down. This will include instructions to call 911 if they see a fire and when system is back on line
- .7 The Contractor will plan to use temporary protection such as extra extinguishers, charged hose lines and temporary sprinkler protection during all Fire protection equipment impairment.
- .8 If the sprinkler system is restorable, either in whole or in part, the Contractor or sub-Contractor shall assign someone to restore the system promptly in the event of a fire.
- .9 A fire patrol may need to be established and will include the following at the Contractor's expense:
 - .1 Patrol all halls and high-risk areas affected.
 - .2 Fire patrol shall have access to a phone and call 911 if they see a fire.

- .3 Report all other problems they encounter.
- .4 Remain on patrol until system is back on.
- .10 The Contractor shall inform all sub trades that the Board has a Red Tag Permit System and it shall be used for all Fire protection equipment impairment.
- .11 For ease of use, a Factory Mutual hanging wall kit has been place at all Board Fire protection equipment locations. Supplies of Red Tag Permits are provided there.

1.9. FIRE ALARM MODIFICATIONS AND MAINTENANCE

- .1 Very important changes to Ontario Building Code as they relate to the Standard for the Verification of Fire Alarm Systems CAN/ULC-S537-M have taken effect December 24, 1999. (Minister's Ruling 99-BC-01)
 - .1 Clause 5.1; "Addition of conventional field device(s), or modification(s), to existing input circuit(s) or output circuit(s) shall require re-verification of all devices served by those input circuit(s) or output circuit(s)." If one device is added to a zone, the entire zone or in the case of a single zone panel the entire system is to be verified.
 - .2 Clause 5.2 "Addition of input circuit(s) or output circuit(s) to an existing fire alarm system shall require verification of the new circuit(s) in accordance with this standard, and shall also require all previously existing circuit(s) to be tested as follows:
 - .3 TEST: One conventional field device on each circuit shall be operated to confirm activation of all output circuits in accordance with the systems design." Even though no other zones have been touched, one device per input zone is to be tested when the Fire Alarm system is modified.
 - .4 Clause 5.5 "Where a transponder is added to an existing system, the transponder shall be verified in accordance with subsections 3.2, Wiring; and subsection 3.3 Control Units; and with CAN/ULC-S536, Standard for the Inspection and Testing of Fire Alarm Systems as well as re-verification of existing field devices and verification of new conventional field devices." If a new addressable device is added to a system, the new device is to be tested; as well a test must be conducted on all addressable devices on the loop.
 - .5 Clause 5.6 "Where an existing fire alarm system control unit is replaced with a new control unit, it shall be verified in accordance with CAN/ULC-S536, Standard for the Inspection and Testing of Fire Alarm Systems.

Replacement of any control panel will require the testing of all existing fire alarm devices.

- .2 The Contractor and sub-Contractors shall include in the bid price for the above ULC Standards requirements referenced in the Ontario Building Code.

1.10. INSTALLATION AND/OR REPAIR OF ROOFING

- .1 The Contractor will review with the Consultant and the Board's representative of the location of any asphalt kettles and the dates the kettles will be in use. The Contractor, in the course of performing roofing work, will ensure all personnel utilize the following precautions:
 - .1 Use only kettles equipped with thermometers or gauges in good working order.
 - .2 Locate kettles in a safe place outside of building.
 - .3 Maintain continuous supervision while kettles are in operation and provide metal covers for the kettles to smother any flames in case of fire.
 - .4 All roofing materials stored in locations no closer than 15 meters to any structures.

1.11. FIRE DEPARTMENT ACCESS

- .1 Designated fire routes must be maintained. Fire Department must be advised of any work that would impede fire apparatus response.

1.12. SMOKING PRECAUTIONS

- .1 Smoking is not permitted anywhere on Board properties. Workers who wish to smoke must leave the property, and not within sight of students. Any worker found to be in contravention of the Ontario Smoke Free Act will be subject to legislated fines.

1.13. FLAMMABLE LIQUIDS

- .1 The handling and storage on site of flammable liquids are to be governed by the current National Fire Code of Canada.
- .2 Flammable liquids such as gasoline, kerosene and naphtha may be kept for ready use in quantities not exceeding 10 imperial gallons provided they are stored in approved safety cans bearing the Underwriter's Laboratory of Canada or Factory Mutual seal of approval.
- .3 Transfer of flammable liquids is prohibited within buildings.

- .4 Transfer of flammable liquids must not be carried out in the vicinity of open flame or any type of heat producing devices.
- .5 Flammable liquids having a flash point below 100° F (37.7°C) such as naphtha or gasoline must not be used as solvents or cleaning agents.
- .6 Flammable waste liquids, for disposal, must be stored in approved containers located in a safe ventilated area. Quantities are to be kept to a minimum.

END OF SECTION

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Contractor Hot Work Permit

1. Take all precautions to Work safely and to provide the necessary protection to persons and property from Hot Work. This includes, but is not limited to Brazing, Cutting, Grinding, Soldering, Thawing Pipe, Torch Applied Roofing and Welding. With all such activity these steps are to be followed:
 - A. Whenever possible, complete Hot Work in a welding shop or out of doors at the school.
 - B. Flammable liquids, dust lint and oily deposits to be removed from within 50-ft (15m) of Work. Remove other combustibles where possible. Otherwise protect with fire-resistive tarpaulins or metal shields.
 - C. Explosive atmosphere in area eliminated. Floors swept clean. Combustible floors wet down, covered with damp sand or fire-resistive tarpaulins.
 - D. All wall and floor openings covered. Fire-resistive tarpaulins suspended beneath Work.
 - E. For Work on walls or ceilings, remove combustibles away on other side.
2. For on-site Work (indoor, out of doors), advise the Head Custodian and Principal prior to Work being performed, and of related dangers.
3. In the event of a fire as a result of the Hot Work, notify the fire department and the head custodian immediately, whether extinguished or not.
4. Barriers must be set up to protect staff and students (i.e. pylons, shields, and caution tape) from exposure to arc flash and smoke migration.
5. Have all necessary doors, windows and/or drapes closed. Request of the head custodian to shut down all fan systems in the area to reduce or eliminate smoke distribution.
6. Provide and keep fire extinguishers handy and in good Working condition. Temporarily cover all smoke detectors in area during time of Work.
7. Provide a fire watch/spot check for several hours after Work is completed. Uncover smoke detectors.



Appendix - 013517-A

Facility Services

CONTRACTOR HOT WORK PERMIT

STOP!

Avoid hot work or seek an alternative method if possible.

This hot work permit is required for any temporary operation involving open flames or producing heat and/or sparks.
 This includes but is not limited to: brazing, cutting, grinding, soldering, torch-applied roofing and welding.

A SEPARATE PERMIT IS REQUIRED FOR EACH AREA

Board Supervisor/ Manager/Proj. Coordinator Responsibilities:

- i. Verify precautions taken in Section A
- ii. Complete and retain Part 1
- iii. Complete Section B prior to commencement of Hot Works
- iv. Issue Part 2 to Contractor completing Hot Work & Post
- v. Obtain Part 2 when Fire Monitoring complete
- vi. Return Part 1 and Part 2 to Controller, Facility Services

Contractor Responsibilities:

- i. Verify precautions taken in Section A
- ii. Complete Section C during each day that Hot Works takes place
- iii. Return Part 2 to Board Supervisor/ Manager/Proj. Coordinator

PART 1

Section A Indicate Precautions Taken
<input type="checkbox"/> Available sprinklers, hose streams, and extinguishers available and in service
Within 35' or 11m of hot work
<input type="checkbox"/> Flammable liquid, dust, lint and oily deposits removed
<input type="checkbox"/> Explosive atmosphere in area eliminated
<input type="checkbox"/> Floors swept clean
<input type="checkbox"/> All wall and floor openings covered
<input type="checkbox"/> Combustible floors covered with fire resistant sheets
<input type="checkbox"/> Protect or shut down ducts that might carry sparks/smoke
Hot work on walls, ceiling or roofs
<input type="checkbox"/> Construction is noncombustible and without combustible covering or insulation
<input type="checkbox"/> Combustible materials on other side of walls, ceilings or roofs moved away
<input type="checkbox"/> Combustible structure wetted down
Hot work on enclosed equipment
<input type="checkbox"/> Enclosed equipment cleaned of all combustible material
<input type="checkbox"/> Containers purged of flammable liquid/vapour
<input type="checkbox"/> Pressurized vessels, piping & equipment removed from service, isolated & vented
Fire watch/hot work and monitoring
<input type="checkbox"/> Fire watch will be provided <u>during</u> and for <u>1 hour</u> after work including break
<input type="checkbox"/> Fire watch is trained and supplied with suitable extinguishers
<input type="checkbox"/> Fire watch is trained in the use of sounding fire alarm
<input type="checkbox"/> Fire watch conducted in adjoining areas, above and below the space where appropriate
<input type="checkbox"/> Monitor hot work area for an additional <u>2 hours</u> after fire watch
<input type="checkbox"/> Other precautions taken (please detail):
_____ _____ _____ _____

Section B Authorization Granted
Board Supervisor/Manager/Proj. Coordinator: _____
Print Name _____ Signature _____
Permit Valid from / to: (max. 7 days) _____
From This Date _____ To This Date _____
(Maximum 7 days or until end of hot work whichever is sooner)

Section C Contractor and Location Affected			
Dates: (max 7 days)	Name of Contractor conducting hot work	Name & signature of individual assigned to fire watch	Name & signature of individual assigned to fire monitoring
School: _____			
Room/Area: _____			
Nature of Job: _____			
I verify the above location has been examined <u>each day</u> , the precautions listed in Section A have been taken <u>each day</u> , and permission is authorized for this work. I further acknowledge that if activity is during <u>school operational hours</u> , that appropriate <u>notification</u> has been given <u>to school</u> administration.			
Hot Works Contractor: _____		Signature _____	
School Administrator notified: _____		Print Name _____	
In Case of Emergency call: 911 - Then call: 519-570-0003 Ext. 4123			

Refer to WRDSB Administration Procedure 4200 Hot Works/Fire Watch (Copies Available on Request)

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SECTION 01 35 23 – HEALTH AND SAFETY

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 31 00 - Project Managing and Coordination.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 35 17 – Fire Safety Requirements
- .4 Section 01 35 43 – Hazardous Materials
- .5 Section 01 41 00 – Regulatory Requirements
- .6 Section 01 53 00 – Temporary Construction Facilities
- .7 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. REFERENCES

- .1 Province of Ontario, including requirements for a "Prime Contractor" as defined by the Act.

1.3. SAFETY PLAN

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to commencing any site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Consultant may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.
- .3 Be governed by pertinent safety requirements of Federal or Provincial Governments and of municipal bodies having authority, particularly the Ontario Construction Safety Act, The Occupational Health and Safety Act for Ontario, and regulations of Ontario Ministry of Labour, and work in conjunction with proper safety associations operating under the authority of Ontario Workers' Compensation Act. Protect Owner, Owner's employees, the public and those employed on the Work from bodily injury and to protect adjacent public and private property and Owner's property from damage. Furnish and maintain protection, such as warning signs, tarpaulins, guard rails, barriers, guard lights, night lights, railings around shafts, pits and stairwells, etc. as required. Remove temporary protective measures when no longer required.

1.4. TEMPORARY WORK

- .1 Temporary work requiring engineering proficiency for the design, erection, operation maintenance and removal shall be designed and bear stamp of the registered professional Engineer or Architect. Detail drawings will be submitted to the Consultant for review prior to commencing any work.
- .2 Before a temporary structure is used, person responsible for design, or their representative, shall inspect structure and certify it has been constructed according to their design.

1.5. RESPONSIBILITY

- .1 The "Prime Contractor" according applicable local jurisdiction, is responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.
- .3 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, and follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Health and Safety Act having jurisdiction. Advise the Board and the Consultant verbally and in writing.
- .4 The Contractor shall make their own arrangements for emergency treatment of accidents. Any accidents shall be reported immediately to the Board contact.
- .5 The Contractor agrees to hold the Board harmless of any and all liability of every nature and description, which may be suffered through bodily injuries, involving deaths of any persons, by reasons of negligence of the Contractor, his agents, employees, or his sub-Contractors.

1.6. SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00.
- .2 Submit site-specific Health and Safety Plan: Within ten (10) days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation

- .3 Submit one (1) copy of Contractor's authorized representative's work site health and safety inspection reports to Consultant and Owner.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit Material Safety Data Sheets (MSDS) to Consultant.
- .7 Consultant's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .8 Medical Surveillance: Where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Consultant.
- .9 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.
- .10 File Notice of Project with the Ministry of Labour prior to commencement of Work.

1.7. SAFETY ACTIVITIES

- .1 Perform site specific safety hazard assessment related to project.
- .2 Schedule and administer Health and Safety meeting with Consultant prior to commencement of Work.
- .3 Perform Work in accordance with Section 01 41 00 - Regulatory Requirements and this section.

1.8. HEALTH AND SAFETY COORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
 - .1 have previous experience as a Health & Safety coordinator,
 - .2 have working knowledge of occupational safety and health regulations,
 - .3 be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work,
 - .4 be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan, and
 - .5 be on site during execution of Work.

1.9. POSTING OF DOCUMENTS

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

1.10. CORRECTION OF NON-COMPLIANCE

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

1.11. PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Refer to Section 01 35 43 Hazardous Materials

1.12. HAZARDOUS WORK

- .1 Blasting or other use of explosives is not permitted at the place of work.

1.13. WORK STOPPAGE

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

1.14. LOCKOUT PROCEDURES

- .1 All Work to be done on electrical systems or machinery, where the unexpected switching on of the system or machinery could result in personal injury to a student, staff, employee, or the Contractor's employee, must be done in accordance with the Contractor's standard lockout procedure.
- .2 The Contractor shall provide his/her own locks for the above procedure.
- .3 The lock shall include contact information for the person(s) locking out such device.

1.15. OVERHEAD LIFTING

- .1 Under no circumstances will a crane or lifting device be used over a occupied space.
- .2 When working adjacent to occupied spaces, ensure a clearance of one (empty) classroom, or a minimum of 10m between any occupied space and the furthest possible reach of the crane.

1.16. WARNING SIGNS AND NOTICES

- .1 Notices shall be posted advising of the hazard but will not be considered a substitute for providing approved protection, separation, and space from the hazard.

1.17. FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by the governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.
- .3 Maintain placed or installed Fire Protection to protect the portions of the Work during construction.

1.18. SCENT-FREE ENVIRONMENT

- .1 The Board requires that, where advised, a building may be deemed scent-free and as such, the wearing of scented products is prohibited.
- .2 Any methods or materials that are found to create negative responses in staff or students shall cease and be removed under advisement of the Consultant and or the Board, until alternate methods can be determined.

END OF SECTION

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SECTION 01 35 43 – HAZARDOUS MATERIALS

2.0 GENERAL

2.1. RELATED SECTIONS

- .1 Section 01 35 23 – Health and Safety Requirements.
- .2 Section 01 41 00 – Regulatory Requirements.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

2.2. REFERENCES

- .1 Province of Ontario, including requirements for a "Prime Contractor" as defined by the Act.

2.3. ASBESTOS and OTHER REGULATED SUBSTANCES

- .1 An Asbestos Audit, as prepared by MTE Consultants Inc. for this facility, is attached under Appendix 013543 A. A duplicate set is also available in the Facilities Services Departments located in the Education Centre. Unless specifically covered by a Cash Allowance or Contingency Allowance that states otherwise, include in this Contract the required removal of all asbestos containing materials (ACM) to complete the work. No claims for extra costs will be accepted for areas known to contain ACM that are within the scope of this Work.
- .2 Comply with applicable legislation regarding asbestos. Should the Contractor encounter asbestos not noted in the referenced Asbestos Audit that would be disturbed during the course of the Work, they should stop the work in that immediate area and report the same to the Consultant and Board contact.
- .3 In addition, Lead, Mercury, Silica, and Isocyanates are anticipated to be present in existing facilities. New construction, renovations, or alterations require compliance by the Contractor with the applicable legislation.

2.4. PROTOCOL FOR ABATEMENT WORK

- .1 This Protocol establishes the requirements to be followed by all Asbestos Abatement Contractors involved with the Board. It applies to Type 1, Type 2 and Type 3 Operations as stated in the Regulations and applies to emergency and non-emergency work (directly retained or working as a sub-contractor).
- .2 Asbestos Abatement Contractors must maintain appropriate insurance coverage and WISB certification.

- .3 Contractors retained for asbestos abatement work shall use personnel certified by the Ontario College of Trades and must provide the Consultant and Board with proof of asbestos certification (AAS and AAW) for all supervisors / all staff involved.
- .4 School Access
 - .1 During school hours all asbestos contractors are to report to the school office upon arrival. After school hours, ensure card-in / card-out procedures are followed and building security is maintained.
- .5 Communication
 - .1 Establish communication contact list with email and phone numbers that shall include:
 - .1 Principal / Vice Principal
 - .2 Area Facility Manager
 - .3 Head Custodian
 - .4 Environmental Officer
 - .5 Manager of Mechanical, Electrical and Environmental Services
 - .6 Manager of Health Safety & Security
 - .7 Contractor staff
 - .8 Consultant
 - .2 Contact the School Principal / Vice to set up a firm date for the abatement (removal / repair). Schedule to allow at least 72 hours notice ahead of the work.
 - .3 Confirm the date by notifying via email the following:
 - .1 Principal / Vice-principal,
 - .2 Area Facility Manager, and
 - .3 Environmental Officer.
 - .4 Consultant
 - .4 Indicate the date, the start time, the anticipated completion time for the work and the work areas in the school.
 - .5 Identify personnel managing the project and provide current cell numbers for emergency contacts.
 - .6 For emergency work, as requested by Area Supervisors, Facility Managers or Environmental Officer, no notification to the school is required.
 - .7 Additionally, for Type 3 work also contact:
 - .1 Manager of Health, Safety & Security, and
 - .2 Notify the MOL (also for Type 2) where required by regulation.
 - .3 Consultant

- .8 Discussions with other groups, school staff, media and others is discouraged and shall be directed to the Board Communication Officer where warranted.
- .6 Asbestos Operations
 - .1 Emergency work shall be carried out the same day (evening/night) or under exceptional conditions the following day / evening / night. Contractors shall exercise discretion when working in the school to minimize anxiety of staff/school community. Where warranted, contact Area Supervisor, Facility Manager or Environmental Officer to obtain further direction.
 - .2 For non-emergency work, contractor is to assess the work on site and provide a cost estimate to the Environmental Officer, (daniela_budure@wrdsb.on.ca) and Consultant. Some work will require discussion with the Facility Manager or Environmental Officer to assess if additional work should be done as to completely remove all ACM material form the area or similar.
 - .3 Where the MTE report shows ACM requiring repair, remove and re-insulate where required.
 - .4 Before beginning any Type 1, Type 2 or Type 3 Operations, the work area must be secured, doors closed, warning signs added to all entrances, caution tape used in open areas and signs used to restrict access to the work area so as to keep persons not involved in the work from entering in the work area.
 - .5 Provide "Construction" warning signs on solid barriers between the Work and public areas. Install a sufficient number of "asbestos abatement" warning signs behind the barriers, posted to warn of the hazard, and that access to the work area is restricted to persons wearing protective clothing and equipment.
 - .6 The contactor is responsible to disable the mechanical ventilation serving the work area and positively prevent operation using Lock-out / Tag-out devices for each air handling unit /fan. Exercise caution during heating season to ensure areas of the building are maintained above freezing and ensure equipment is turned back on after abatement / air clearance completed.
 - .7 Contractor's employees shall put on / take off PPE within work area marked by construction signs. No employee shall leave the work area wearing PPE.

- .8 All dust and waste is to be cleaned up and removed at frequent / regular intervals as the work proceeds and immediately upon completion. No waste bags or similar are to be left behind.

2.5. SUBMITTALS

- .1 Once the abatement is completed, forward a Letter of Completion to the Environmental Officer, (daniela_budure@wrdsb.on.ca). This letter shall be received no later than 72 hours after completion and shall include any sample results.
- .2 For those projects requiring Air Clearance, ensure this info is sent without delay but in all cases no later than 24 hours after sampling. All Type 3 work must take into account that the initial samples may not pass and the contactor must allow one additional day to re-clean and re-sample before school is to resume operations. For those projects not under the direct supervision of a Environmental Consultant, the contactor is to expedite the air clearance sampling with the lab of their choice and carry these costs.
- .3 Forward Air Clearance results to:
 - .1 Principal / Vice-principal,
 - .2 Facility Manager,
 - .3 Environmental Officer,
 - .4 Manager of Mechanical, Electrical and Environmental Services, and
 - .5 Manager of Health, Safety & Security.
 - .6 Consultant

2.6. ACKNOWLEDGEMENT

- .1 The protocols for asbestos work must be read and understood by Asbestos Contractor.
- .2 Submit a signed copy of the most current copy of PROTOCOL FOR ABATEMENT WORK (ASBESTOS ABATEMENT CONTRACTORS) to the General Contractor, the Consultant, and the Board's Environmental Officer.

END OF SECTION



February 1, 2019
MTE File No.: C34532-917

Waterloo Region District School Board
51 Ardelt Avenue
Kitchener, ON N2C 2R5

**Re: 2019 Asbestos Audit Update – Park Manor Public School
18 Mockingbird Drive, Elmira, Ontario**

1.0 INTRODUCTION

MTE Consultants Inc. (MTE) was authorized by the Waterloo Region District School Board (WRDSB) to conduct the 2019 Asbestos Audit Update for the subject building.

The purpose of the assignment was to re-assess and document the location, type, and condition of identified asbestos-containing materials (ACM) present within the building and make appropriate recommendations for management, abatement or remedial activities, as required.

The audit was conducted in accordance with the Ontario Ministry of Labour, *Regulation 278/05-Designated Substance-Asbestos on Construction Projects and in Buildings and Repair Operations* (O. Reg. 278/05). This report shall replace previous audit reports.

2.0 SCOPE OF WORK

The Scope of Work for this assessment was completed by MTE and included the following activities:

- Review of existing and historical reports and documentation pertaining to ACM within the building;
- Visual inspection to assess the condition of previously identified ACM, excluding portable structures;
- Collection of building material samples that are suspect ACM, as applicable;
- Submission of samples to an accredited laboratory, as applicable;
- Photographic log of damaged materials; and
- Preparation of this report with findings and recommendations.

3.0 METHODOLOGY AND ASSESSMENT CRITERIA

This inspection was conducted by visual and laboratory identification methods for the assessment of ACM and their corresponding location, use, condition, and friability. The areas outlined in Section 2.0 were inspected limited to building components, materials and service connections. Notwithstanding that reasonable attempts were made to identify all ACMs, the possibility of concealed material exists and may not become visible until substantial demolition has occurred and therefore are currently undocumented and did not include the following.

- Locations that may be hazardous to the surveyor, such as electrical equipment;
- Where invasive inspection could cause consequential damage to the property or impair the integrity of the equipment, such as roof systems, underground services or components of mechanical equipment;
- Locations concealed by building finishes that require substantial demolition or removal for access or determination of quantities;
- Materials that is present in such an inconsistent fashion that without complete removal of finishes, the extent cannot be determined.
- Non-permanent items or personal contents, furnishings; and
- Settled dust or airborne agents unless otherwise stated.

3.1 Condition of ACM

During the audit process the general condition of ACMs were observed and noted. Materials which are damaged can pose an increased exposure risk to workers, building occupants and the public. While assessing damage can be subjective, abatement items were grouped into two categories to aid in remedial prioritization.

Monitor Annually

These are items which display minor isolated damage; however do not pose an immediate risk to workers from exposure to asbestos fibres due to the current condition of the material and/or location. No remediation is required at this time; however these items should be monitored on a yearly basis for evidence of continued degradation. Should the condition of the material change an evaluation should be completed by a competent person to determine remedial action.

Abatement Action Required

These are items which display damage and may pose potential risk to workers from exposure to asbestos fibres due to the physical condition and/or location of the material. Clean-up, repair or removal of these materials is required as soon as reasonably possible.

4.0 FINDINGS

An inspection of the building was conducted by MTE on January 25, 2019. The single-storey school building was constructed in 1972. The inspection did not include areas of post 1990 construction or renovation (where all building finishes have been removed and replaced), as applicable.

The Asbestos Management Database is provided in **Appendix A** and associated Figures are provided in **Appendix B**. These together provide a current summary of the ACM identified throughout the building.

A summary of the damaged ACM identified at the time of the inspection is provided in **Appendix C**.

The bulk asbestos sample location and analytical summary is provided in **Appendix C**, and Laboratory Certificates of Analysis for any sampling conducted as part of the 2019 inspection are also provided, as applicable.

4.1 Analytical Results

During this inspection, a total of 12 building material samples that are suspect ACM were collected with a total of 10 analyses being performed. Equal to or greater than 0.5%, asbestos by dry weight, the laboratory method detection limit (MDL), classifies the material as ACM according to O. Reg. 278/05. Samples collected were submitted for analysis to Paracel Laboratories Ltd. (Paracel), in Mississauga, Ontario. Paracel is certified under the National Voluntary Laboratory Accreditation Program to perform asbestos analysis of bulk samples by PLM. Laboratory analysis was conducted in accordance with the United States Environmental Protection Agency, Test Method EPA/600-R-93/116: Method for the Determination of Asbestos in Bulk Building Materials, June, 1993 by Polarized Light Microscopy as prescribed by O. Reg. 278/05.

Refer to Appendix C, Table 3 for a detailed summary of the analytical results for each sampled material.

4.2 Removed ACM

No ACM has been removed since the previous audit.

4.3 Discovery of Additional ACM

No additional ACM or suspect ACM was identified.

4.4 Damaged ACM

Damaged ACM was identified. Refer to **Appendix C, Tables 1 and 2** for a detailed summary of required actions, specific to each material. At the time of the audit, all other ACM at the building was noted to be in good condition.

5.0 RECOMMENDATIONS

5.1 Remedial

Damaged ACM was identified. Refer to Appendix C, Tables 1 and 2 for a detailed summary of required actions, specific to each material. At the time of the audit, all other ACM at the building was noted to be in good condition.

Type 1 abatement operations may be conducted internally by trained and qualified WRDSB staff. All other abatement work must be conducted by certified asbestos contractors trained and qualified to conduct the type of work required.

All asbestos work must be conducted by staff and/or contractors who are trained and experienced in the type of asbestos operations required, and should be overseen by a qualified third party Health, Safety and Environmental professional. In order to conduct Type 3 asbestos operations, contractors must be certified as Asbestos Abatement Workers AAW (Trade code 253W) and Asbestos Abatement Supervisors AAS (Trade code 253S) by The Ministry of Training, Colleges and Universities (Ministry of Advanced Education and Skills Development) as prescribed by Section 20 of O. Reg. 278/05.

5.2 Long Term Management

This audit was conducted for the long term management of ACM within the building. Prior to future construction or renovation projects, additional assessments and/or sampling may be required.

There are no requirements under current legislation to remove ACM from a building simply because it is present. However, O. Reg. 278/05 requires that an Asbestos Management Plan be implemented and maintained. Asbestos awareness training should be provided for staff that may come in contact with ACM during routine duties or in emergency situations.

ACM that will be disturbed, or will likely be disturbed, during building maintenance, renovations, construction, or demolition activities must be handled and disposed of in accordance with the procedures prescribed by O. Reg. 278/05.



ACM may also be present in concealed locations. If any construction, renovation, alteration, or maintenance activities are required or planned, invasive inspections of concealed locations for potential ACM must be performed prior to such activities. Should any suspect ACM be discovered, work should cease and the materials should not be disturbed. Suspect ACM must be treated as asbestos-containing or sampled and proven to not contain asbestos. Any activities that require disturbance of ACM must be performed in accordance with O. Reg. 278/05.

6.0 LIMITATIONS

Services performed by **MTE Consultants Inc.** (MTE) were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the Environmental Engineering & Consulting profession. No other representation expressed or implied as to the accuracy of the information, conclusions or recommendations is included or intended in this report.

This report was completed for the sole use of MTE and the Client. It was completed in accordance with the approved Scope of Work referred to in Section 2.0. As such, this report may not deal with all issues potentially applicable to the site and may omit issues that are or may be of interest to the reader. MTE makes no representation that the present report has dealt with all-important environmental features, except as provided in the Scope of Work. All findings and conclusions presented in this report are based on site conditions, as they existed during the time period of the investigation. This report is not intended to be exhaustive in scope or to imply a risk-free facility.

Any use which a third party makes of this report, or any reliance on, or decisions to be made based upon it, are the responsibility of such third parties. MTE accepts no responsibility for liabilities incurred by or damages, if any, suffered by any third party as a result of decisions made or actions taken, based upon this report. Others with interest in the site should undertake their own investigations and studies to determine how or if the condition affects them or their plans.

It should be recognized that the passage of time might affect the views, conclusions and recommendations (if any) provided in this report because environmental conditions of a property can change. Should additional or new information become available, MTE recommends that it be brought to our attention in order that we may re-assess the contents of this report.

All of which is respectfully submitted,

MTE CONSULTANTS INC.



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Attach.



APPENDIX A

ASBESTOS MANAGEMENT DATABASE



	School Name	Legend:	Notes:
	Park Manor Public School	HM - Homogenous Material - homogeneous with previously sampled material SL - Sample Location - Material Sampled	<p>All quantities provided on Figures, if known. Refer to the Asbestos Audit Update Report for condition of ACM and recommended actions.</p> <p>Dates provided in Material Description/Room Description columns indicates date of installation/renovation and confirms the finishes as non-ACM.</p>
	Date Built:	VC - Visually Confirmed - Material not sampled, deemed ACM	
	Original: 1972	NF - Non-Friable	
Addition(s): N/A	F- Friable		

WRDSB Fixed Reference Number	Room Description	Inspected Item	Inspected Material	Material Description	Friability	Asbestos Classification	Sample / Identification Summary	Sample ID	Sample Date	% Asbestos & Fibre Type
Structure/Additions										
	Original 1972 Building	Structure	Deck	Steel	-	Non ACM	-	-	-	-
	Original 1972 Building	Structure	Concrete	Concrete	-	Non ACM	-	-	-	-
	Original 1972 Building	Façade	Brick Veneer	Brick and Mortar	-	Non ACM	-	-	-	-
	Original 1972 Building	Not Inspected	Not Inspected	Roofing Materials	NF	Suspect ACM	VC	-	-	-
	Original 1972 Building	Windows	Interior Frames	Black Sealant	-	Non ACM	HM	S01	25-Jan-19	ND
	Original 1972 Building	Windows	Interior Panes	Black Sealant	-	Non ACM	HM	S01	25-Jan-19	ND
	Original 1972 Building	Windows	Exterior Frames	Grey Sealant	-	Non ACM	SL	S04	25-Jan-19	ND
	Original 1972 Building	Doors	Interior Frames	White Sealant	-	Non ACM	SL	S02	25-Jan-19	ND
	Original 1972 Building	Doors	Exterior Frames	Black Sealant	-	Non ACM	SL	S01	25-Jan-19	ND
	Original 1972 Building	Doors	Exterior Panes	Grey Sealant	NF	ACM	SL	S03	25-Jan-19	0.5% Chrysotile
	Original 1972 Building	Mastic	Mastic	Floor Tile Mastic	-	Non ACM	SL	32523-PARKM-S03, 32523-PARKM-S05, 32523-PARKM-S07	7/15/2008	ND
Level 1										
1A	Classroom	Floor	Hardwood	-	-	Non ACM	-	-	-	-
1A	Classroom	Floor	Vinyl Floor Tile 12"x 12"	Beige Oatmeal	-	Non ACM	HM	S05abc	7/15/2008	ND
1A	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
1A	Classroom	Ceiling Deck	Metal	-	-	Non ACM	-	-	-	-
1A	Classroom	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
2	Classroom	Floor	Vinyl Floor Tile 12"x 12"	Light Beige/Brown/White Fleck	NF	ACM	SL	S09abc	7/15/2008	1.2% Chrysotile
2	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
2	Classroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
2	Classroom	Piping	Rain Water Leader	Transite	NF	ACM	VC	-	-	-
3	Classroom	Floor	Vinyl Floor Tile 12"x 12"	Pink/Brown/White Fleck	NF	ACM	HM	S07abc	7/15/2008	1.2% Chrysotile
3	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
3	Classroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
4	Music Room	Floor	Carpet	-	-	Non ACM	-	-	-	-
4	Music Room	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
4	Music Room	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
4	Music Room	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
4	Music Room	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
4A	Practice Room	Floor	Carpet	-	-	Non ACM	-	-	-	-
4A	Practice Room	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
4A	Practice Room	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
4A	Practice Room	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
4A	Practice Room	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
4B	Exterior Storage	Floor	Concrete	-	-	Non ACM	-	-	-	-
4B	Exterior Storage	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
4B	Exterior Storage	Ceiling Deck	Metal	-	-	Non ACM	-	-	-	-



	School Name	Legend:	Notes:
	Park Manor Public School	HM - Homogenous Material - homogeneous with previously sampled material SL - Sample Location - Material Sampled	<p>All quantities provided on Figures, if known. Refer to the Asbestos Audit Update Report for condition of ACM and recommended actions.</p> <p>Dates provided in Material Description/Room Description columns indicates date of installation/renovation and confirms the finishes as non-ACM.</p>
	Date Built:	VC - Visually Confirmed - Material not sampled, deemed ACM	
	Original: 1972	NF - Non-Friable F- Friable	
Addition(s): N/A			

WRDSB Fixed Reference Number	Room Description	Inspected Item	Inspected Material	Material Description	Friability	Asbestos Classification	Sample / Identification Summary	Sample ID	Sample Date	% Asbestos & Fibre Type
4B	Exterior Storage	Piping	Rain Water Leader	Transite	NF	ACM	VC	-	-	-
4B	Exterior Storage	Piping	Pipe Fitting	Parged Cement	F	ACM	HM	Pinchin Sample 1680.612.01	12/28/1990	50-75% Chrysotile
5	Classroom	Floor	Vinyl Floor Tile 12"x 12"	Beige Oatmeal	-	Non ACM	SL	S05abc	7/15/2008	ND
5	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
5	Classroom	Wall	Partition Wall	Metal	-	Non ACM	-	-	-	-
5	Classroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
5	Classroom	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
6	Seminar	Floor	Vinyl Floor Tile 12"x 12"	Light Beige Dense Fleck	-	Non ACM	-	-	-	-
6	Seminar	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
6	Seminar	Wall	Partition Wall	Metal	-	Non ACM	-	-	-	-
6	Seminar	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
6A	Classroom	Floor	Vinyl Floor Tile 12"x 12"	Light Beige Dense Fleck	-	Non ACM	-	-	-	-
6A	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
6A	Classroom	Wall	Partition Wall	Metal	-	Non ACM	-	-	-	-
6A	Classroom	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
7	Classroom	Floor	Vinyl Floor Tile 12"x 12"	Light Beige Dense Fleck	-	Non ACM	-	-	-	-
7	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
7	Classroom	Wall	Partition Wall	Metal	-	Non ACM	-	-	-	-
7	Classroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
7	Classroom	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
8	Classroom	Floor	Vinyl Floor Tile 12"x 12"	Brown Oatmeal	-	Non ACM	HM	S01abc	7/15/2008	ND
8	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
8	Classroom	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
8	Classroom	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
8	Classroom	Piping	Rain Water Leader	Transite	NF	ACM	VC	-	-	-
9	Washroom	Floor	Ceramic Tile	-	-	Non ACM	-	-	-	-
9	Washroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
9	Washroom	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
9	Washroom	Ceiling	Drywall	Drywall Joint Compound	NF	ACM	SL	S02abcde	7/15/2008	2.0% Chrysotile
9A	Classroom	Floor	Vinyl Floor Tile 12"x 12"	Light and Dark Beige Dense Fleck	-	Non ACM	-	-	-	-
9A	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
9A	Classroom	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
9A	Classroom	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
9B	Storage	Floor	Vinyl Floor Tile 12"x 12"	Brown Oatmeal	-	Non ACM	HM	S01abc	7/15/2008	ND
9B	Storage	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
9B	Storage	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
9B	Storage	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
10	Classroom	Floor	Vinyl Floor Tile 12"x 12"	White/Grey Fleck	-	Non ACM	HM	S03abc	7/15/2008	ND
10	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
10	Classroom	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
10	Classroom	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
11	Classroom	Floor	Vinyl Floor Tile 12"x 12"	Brown Oatmeal	-	Non ACM	HM	S01abc	7/15/2008	ND



	School Name	Legend:	Notes:
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	Date Built:		
	Original: 1972		
Addition(s): N/A			

WRDSB Fixed Reference Number	Room Description	Inspected Item	Inspected Material	Material Description	Friability	Asbestos Classification	Sample / Identification Summary	Sample ID	Sample Date	% Asbestos & Fibre Type
11	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
11	Classroom	Wall	Partition Wall	Metal	-	Non ACM	-	-	-	-
11	Classroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
12	Seminar	Floor	Vinyl Floor Tile 12"x 12"	Brown Oatmeal	-	Non ACM	HM	S01abc	7/15/2008	ND
12	Seminar	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
12	Seminar	Wall	Partition Wall	Metal	-	Non ACM	-	-	-	-
12	Seminar	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
12A	Classroom	Floor	Vinyl Floor Tile 12"x 12"	Brown Oatmeal	-	Non ACM	HM	S01abc	7/15/2008	ND
12A	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
12A	Classroom	Wall	Partition Wall	Metal	-	Non ACM	-	-	-	-
12A	Classroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
13	Classroom	Floor	Vinyl Floor Tile 12"x 12"	Brown Oatmeal	-	Non ACM	HM	S01abc	7/15/2008	ND
13	Classroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
13	Classroom	Wall	Partition Wall	Metal	-	Non ACM	-	-	-	-
13	Classroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
13A	Office	Floor	Vinyl Floor Tile 12"x 12"	Brown Oatmeal	-	Non ACM	HM	S01abc	7/15/2008	ND
13A	Office	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
13A	Office	Wall	Partition Wall	Metal	-	Non ACM	-	-	-	-
13A	Office	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
14	Computer Lab	Floor	Vinyl Floor Tile 12"x 12"	Brown Oatmeal	-	Non ACM	HM	S01abc	7/15/2008	ND
14	Computer Lab	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
14	Computer Lab	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole Textured	-	Non ACM	HM	S06abc	7/15/2008	ND
15	Computer Lab	Floor	Vinyl Floor Tile 12"x 12"	Brown Oatmeal	-	Non ACM	HM	S01abc	7/15/2008	ND
15	Computer Lab	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
15	Computer Lab	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole Textured	-	Non ACM	HM	S06abc	7/15/2008	ND
16	Computer Lab	Floor	Vinyl Floor Tile 12"x 12"	Brown Oatmeal	-	Non ACM	HM	S01abc	7/15/2008	ND
16	Computer Lab	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
16	Computer Lab	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole Textured	-	Non ACM	HM	S06abc	7/15/2008	ND
30	Library	Floor	Carpet	-	-	Non ACM	-	-	-	-
30	Library	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
30	Library	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole Textured	-	Non ACM	HM	S06abc	7/15/2008	ND
30A	AV Room	Floor	Carpet	-	-	Non ACM	-	-	-	-
30A	AV Room	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
30A	AV Room	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
30A	AV Room	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole Textured	-	Non ACM	HM	S06abc	7/15/2008	ND
30B	Workroom	Floor	Carpet	-	-	Non ACM	-	-	-	-
30B	Workroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
30B	Workroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole Textured	-	Non ACM	HM	S06abc	7/15/2008	ND
31	Custodial	Floor	Vinyl Floor Tile 12"x 12"	Pink/Brown/White Fleck	NF	ACM	HM	S07abc	7/15/2008	1.2% Chrysotile
31	Custodial	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
31	Custodial	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
31	Custodial	Ceiling Deck	Metal	-	-	Non ACM	-	-	-	-



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	Date Built:	VC - Visually Confirmed - Material not sampled, deemed ACM	Dates provided in Material Description/Room Description columns indicates date of installation/renovation and confirms the finishes as non-ACM.
	Original: 1972	NF - Non-Friable F- Friable	
Addition(s): N/A			

WRDSB Fixed Reference Number	Room Description	Inspected Item	Inspected Material	Material Description	Friability	Asbestos Classification	Sample / Identification Summary	Sample ID	Sample Date	% Asbestos & Fibre Type
31	Custodial	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
31	Custodial	Piping	Pipe Fitting	Parged Cement	F	ACM	HM	Pinchin Sample 1680.612.01	12/28/1990	50-75% Chrysotile
31	Custodial	Piping	Rain Water Leader	Transite	NF	ACM	VC	-	-	-
31A	Washroom	Floor	Vinyl Floor Tile 12"x 12"	Pink/Brown/White Fleck	NF	ACM	HM	S07abc	7/15/2008	1.2% Chrysotile
31A	Washroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
31A	Washroom	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
31A	Washroom	Ceiling	Textured Plaster	-	NF	ACM	HM	S08abc	7/15/2008	0.5% Chrysotile
32	Office	Floor	Vinyl Floor Tile 12"x 12"	Light Beige/Brown/White Fleck	NF	ACM	HM	S09abc	7/15/2008	1.2% Chrysotile
32	Office	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
32	Office	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
32	Office	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
32	Office	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
32	Office	Ducting	Duct Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
32A	Office	Floor	Vinyl Floor Tile 12"x 12"	Light Beige/Brown/White Fleck	NF	ACM	HM	S09abc	7/15/2008	1.2% Chrysotile
32A	Office	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
32A	Office	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
32A	Office	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
32A	Office	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
32A	Office	Ducting	Duct Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
33	Health Room	Floor	Vinyl Floor Tile 12"x 12"	Light Green with Brown Fleck	NF	ACM	HM	S11abc	7/15/2008	1.2% Chrysotile
33	Health Room	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
33	Health Room	Wall	Drywall	Drywall Joint Compound	NF	ACM	SL	S02e	7/15/2008	2.0% Chrysotile
33	Health Room	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
33A	Washroom	Floor	Vinyl Floor Tile 12"x 12"	Light Green with Brown Fleck	NF	ACM	HM	S11abc	7/15/2008	1.2% Chrysotile
33A	Washroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
33A	Washroom	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
33A	Washroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
34	Office	Floor	Vinyl Floor Tile 12"x 12"	Pink/Brown/White Fleck	NF	ACM	HM	S07abc	7/15/2008	1.2% Chrysotile
34	Office	Floor	Carpet	-	-	Non ACM	-	-	-	-
34	Office	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
34	Office	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
34	Office	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
34	Office	Ducting	Duct Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
34A	Office	Floor	Carpet	-	-	Non ACM	-	-	-	-
34A	Office	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
34A	Office	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
34A	Office	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
34A	Office	Ducting	Duct Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
34B	Office	Floor	Carpet	-	-	Non ACM	-	-	-	-
34B	Office	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
34B	Office	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
34B	Office	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile



	School Name	Legend:	Notes:
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	Date Built:		
	Original: 1972		
Addition(s): N/A			

WRDSB Fixed Reference Number	Room Description	Inspected Item	Inspected Material	Material Description	Friability	Asbestos Classification	Sample / Identification Summary	Sample ID	Sample Date	% Asbestos & Fibre Type
34B	Office	Ducting	Duct Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
35	Workroom	Floor	Vinyl Floor Tile 12"x 12"	Pink/Brown/White Fleck	NF	ACM	HM	S07abc	7/15/2008	1.2% Chrysotile
35	Workroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
35	Workroom	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
35	Workroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
35	Workroom	Ducting	Duct Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
35	Workroom	Piping	Rain Water Leader	Transite	NF	ACM	VC	-	-	-
36	Staff Room	Floor	Vinyl Floor Tile 12"x 12"	Pink/Brown/White Fleck	NF	ACM	HM	S07abc	7/15/2008	1.2% Chrysotile
36	Staff Room	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
36	Staff Room	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
36	Staff Room	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
36	Staff Room	Floor	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
36	Staff Room	Ducting	Duct Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
36A	Washroom	Floor	Vinyl Floor Tile 12"x 12"	Pink/Brown/White Fleck	NF	ACM	HM	S07abc	7/15/2008	1.2% Chrysotile
36A	Washroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
36A	Washroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
36B	Washroom	Floor	Vinyl Floor Tile 12"x 12"	Pink/Brown/White Fleck	NF	ACM	HM	S07abc	7/15/2008	1.2% Chrysotile
36B	Washroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
36B	Washroom	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
37	General Purpose	Floor	Hardwood	-	-	Non ACM	-	-	-	-
37	General Purpose	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
37	General Purpose	Ceiling Deck	Metal	-	-	Non ACM	-	-	-	-
37	General Purpose	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
37	General Purpose	Piping	Pipe Fitting	Parged Cement	F	ACM	HM	Pinchin Sample 1680.612.01	12/28/1990	50-75% Chrysotile
37	General Purpose	Piping	Rain Water Leader	Transite	NF	ACM	VC	-	-	-
38	Changeroom	Floor	Ceramic	-	-	Non ACM	-	-	-	-
38	Changeroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
38	Changeroom	Ceiling	Textured Plaster	-	NF	ACM	HM	S08abc	7/15/2008	0.5% Chrysotile
38A	Changeroom	Floor	Ceramic	-	-	Non ACM	-	-	-	-
38A	Changeroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
38A	Changeroom	Ceiling	Textured Plaster	-	NF	ACM	HM	S08abc	7/15/2008	0.5% Chrysotile
38B	Changeroom	Floor	Ceramic	-	-	Non ACM	-	-	-	-
38B	Changeroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
38B	Changeroom	Ceiling	Textured Plaster	-	NF	ACM	HM	S08abc	7/15/2008	0.5% Chrysotile
38C	Washroom	Floor	Vinyl Floor Tile 12"x 12"	White/Grey Fleck	NF	ACM	HM	S10abc	7/15/2008	1.4% Chrysotile
38C	Washroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
38C	Washroom	Ceiling	Textured Plaster	-	NF	ACM	HM	S08abc	7/15/2008	0.5% Chrysotile
38D	Office	Floor	Vinyl Floor Tile 12"x 12"	White/Grey Fleck	NF	ACM	HM	S10abc	7/15/2008	1.4% Chrysotile
38D	Office	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
38D	Office	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
39	Lunch Room	Floor	Vinyl Floor Tile 12"x 12"	White/Grey Fleck	NF	ACM	SL	S10abc	7/15/2008	1.4% Chrysotile
39	Lunch Room	Wall	Concrete Block	-	-	Non ACM	-	-	-	-



	School Name	Legend:	Notes:
	Park Manor Public School	HM - Homogenous Material - homogeneous with previously sampled material SL - Sample Location - Material Sampled VC - Visually Confirmed - Material not sampled, deemed ACM NF - Non-Friable F - Friable	All quantities provided on Figures, if known. Refer to the Asbestos Audit Update Report for condition of ACM and recommended actions. Dates provided in Material Description/Room Description columns indicates date of installation/renovation and confirms the finishes as non-ACM.
	Date Built:		
	Original: 1972		
Addition(s): N/A			

WRDSB Fixed Reference Number	Room Description	Inspected Item	Inspected Material	Material Description	Friability	Asbestos Classification	Sample / Identification Summary	Sample ID	Sample Date	% Asbestos & Fibre Type
39	Lunch Room	Wall	Drywall	Drywall Joint Compound	NF	ACM	SL	S02cd	7/15/2008	2.0% Chrysotile
39	Lunch Room	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
39	Lunch Room	Piping	Rain Water Leader	Transite	NF	ACM	VC	-	-	-
39	Lunch Room	Ducting	Duct Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
39A	Tuck Shop	Floor	Vinyl Floor Tile 12"x 12"	Light Beige/Brown/White Fleck	NF	ACM	HM	S09abc	7/15/2008	1.2% Chrysotile
39A	Tuck Shop	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
39A	Tuck Shop	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
39A	Tuck Shop	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
39B	Lunch Room	Floor	Vinyl Floor Tile 12"x 12"	White/Grey Fleck	NF	ACM	SL	S10abc	7/15/2008	1.4% Chrysotile
39B	Lunch Room	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
39B	Lunch Room	Wall	Drywall	Drywall Joint Compound	NF	ACM	SL	S02cd	7/15/2008	2.0% Chrysotile
39B	Lunch Room	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
39B	Lunch Room	Ducting	Duct Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
40	Changeroom	Floor	Ceramic	-	-	Non ACM	-	-	-	-
40	Changeroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
40	Changeroom	Ceiling	Textured Plaster	-	NF	ACM	HM	S08abc	7/15/2008	0.5% Chrysotile
40A	Changeroom	Floor	Ceramic	-	-	Non ACM	-	-	-	-
40A	Changeroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
40A	Changeroom	Ceiling	Textured Plaster	-	NF	ACM	HM	S08abc	7/15/2008	0.5% Chrysotile
40B	Changeroom	Floor	Ceramic	-	-	Non ACM	-	-	-	-
40B	Changeroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
40B	Changeroom	Ceiling	Textured Plaster	-	NF	ACM	HM	S08abc	7/15/2008	0.5% Chrysotile
40C	Washroom	Floor	Vinyl Floor Tile 12"x 12"	White/Grey Fleck	NF	ACM	HM	S10abc	7/15/2008	1.4% Chrysotile
40C	Washroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
40C	Washroom	Ceiling	Textured Plaster	-	NF	ACM	HM	S08abc	7/15/2008	0.5% Chrysotile
40D	Office	Floor	Vinyl Floor Tile 12"x 12"	White/Grey Fleck	NF	ACM	HM	S10abc	7/15/2008	1.4% Chrysotile
40D	Office	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
40D	Office	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
41	General Purpose	Floor	Hardwood	-	-	Non ACM	-	-	-	-
41	General Purpose	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
41	General Purpose	Ceiling Deck	Metal	-	-	Non ACM	-	-	-	-
41	General Purpose	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
41	General Purpose	Piping	Pipe Fitting	Parged Cement	F	ACM	HM	Pinchin Sample 1680.612.01	12/28/1990	50-75% Chrysotile
42	Storage	Floor	Concrete	-	-	Non ACM	-	-	-	-
42	Storage	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
42	Storage	Ceiling Deck	Metal	-	-	Non ACM	-	-	-	-
42	Storage	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
42	Storage	Piping	Pipe Fitting	Parged Cement	F	ACM	HM	Pinchin Sample 1680.612.01	12/28/1990	50-75% Chrysotile
43	Washroom	Floor	Ceramic Tile	-	-	Non ACM	-	-	-	-
43	Washroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
43	Washroom	Ceiling	Textured Plaster	-	NF	ACM	SL	S08abc	7/15/2008	0.5% Chrysotile
44	Washroom	Floor	Ceramic Tile	-	-	Non ACM	-	-	-	-



	School Name	Legend:	Notes:
	Park Manor Public School	HM - Homogenous Material - homogeneous with previously sampled material SL - Sample Location - Material Sampled VC - Visually Confirmed - Material not sampled, deemed ACM NF - Non-Friable F - Friable	All quantities provided on Figures, if known. Refer to the Asbestos Audit Update Report for condition of ACM and recommended actions. Dates provided in Material Description/Room Description columns indicates date of installation/renovation and confirms the finishes as non-ACM.
	Date Built:		
	Original: 1972		
Addition(s): N/A			

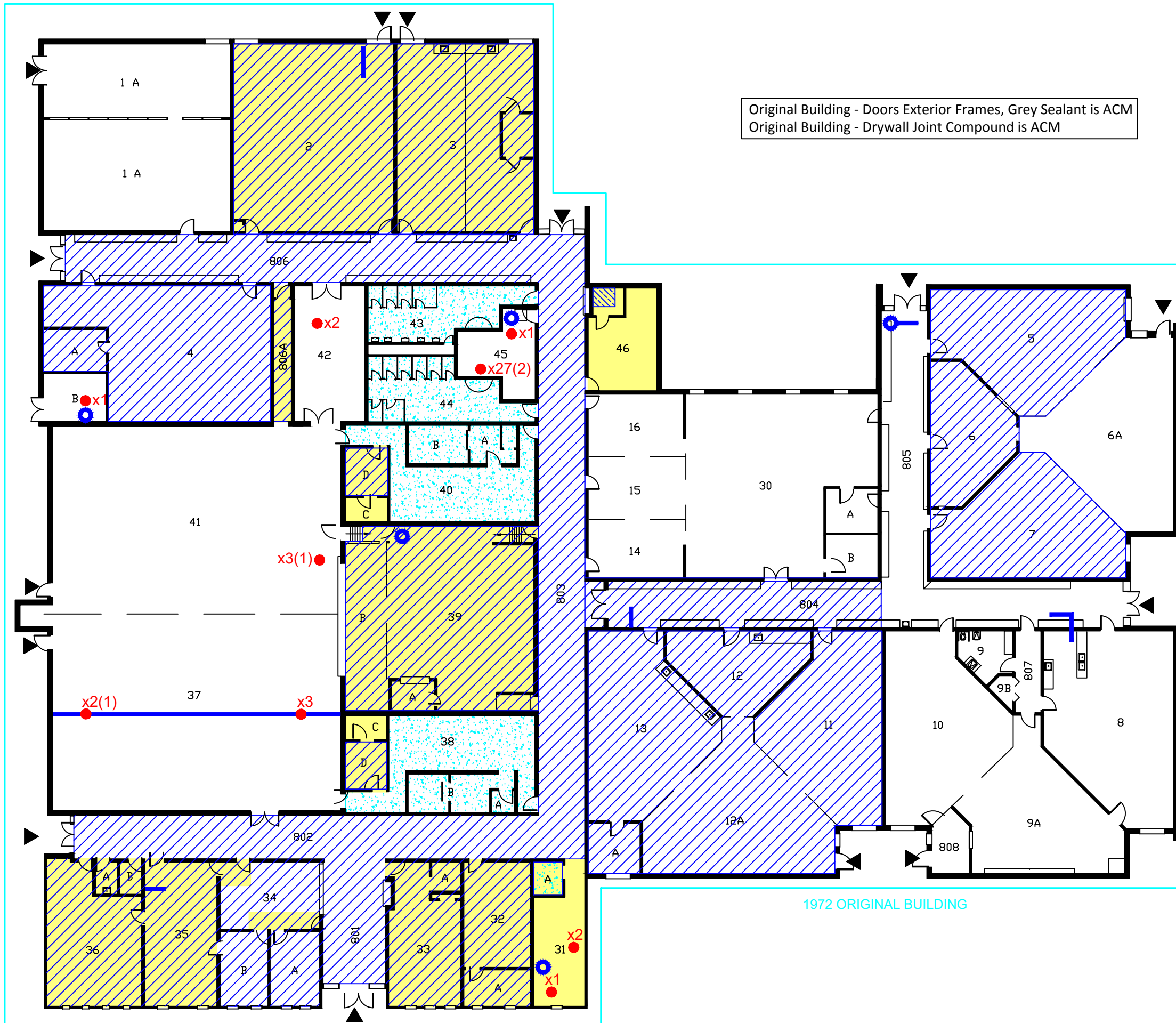
WRDSB Fixed Reference Number	Room Description	Inspected Item	Inspected Material	Material Description	Friability	Asbestos Classification	Sample / Identification Summary	Sample ID	Sample Date	% Asbestos & Fibre Type
44	Washroom	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
44	Washroom	Ceiling	Textured Plaster	-	NF	ACM	HM	S08abc	7/15/2008	0.5% Chrysotile
45	Custodial	Floor	Concrete	-	-	Non ACM	-	-	-	-
45	Custodial	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
45	Custodial	Ceiling Deck	Metal	-	-	Non ACM	-	-	-	-
45	Custodial	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
45	Custodial	Piping	Pipe Insulation	Transite	NF	ACM	VC	-	-	-
45	Custodial	Piping	Pipe Fitting	Parged Cement	F	ACM	HM	Pinchin Sample 1680.612.01	12/28/1990	50-75% Chrysotile
46	Storage/Kiln	Floor	Vinyl Floor Tile 12"x 12"	Pink/Brown/White Fleck	NF	ACM	SL	S07abc	7/15/2008	1.2% Chrysotile
46	Storage/Kiln	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
46	Storage/Kiln	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
46	Storage/Kiln	Ceiling Deck	Metal	-	-	Non ACM	-	-	-	-
46	Storage/Kiln	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
46	Storage/Kiln	Board	Transite board	Transite	NF	ACM	VC	-	-	-
46	Storage/Kiln	Kiln	Kiln Refractory	Refractory	F	ACM	-	-	-	-
801	Corridor	Floor	Terrazzo	-	-	Non ACM	-	-	-	-
801	Corridor	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
801	Corridor	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
801	Corridor	Ducting	Duct Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
802	Corridor	Floor	Terrazzo	-	-	Non ACM	-	-	-	-
802	Corridor	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
802	Corridor	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
802	Corridor	Ceiling	Ceiling Tile 2 x 4	Thick Fissure Random Pinhole	-	Non ACM	SL	S12abc	7/15/2008	ND
802	Corridor	Ducting	Duct Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
803	Corridor	Floor	Terrazzo	-	-	Non ACM	-	-	-	-
803	Corridor	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
803	Corridor	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
803	Corridor	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole Textured	-	Non ACM	HM	S06abc	7/15/2008	ND
803	Corridor	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
803	Corridor	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
804	Corridor	Floor	Ceramic Tile	-	-	Non ACM	-	-	-	-
804	Corridor	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
804	Corridor	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
804	Corridor	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
804	Corridor	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
804	Corridor	Piping	Rain Water Leader	Transite	NF	ACM	VC	-	-	-
805	Corridor	Floor	Ceramic Tile	-	-	Non ACM	-	-	-	-
805	Corridor	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
805	Corridor	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole Textured	-	Non ACM	SL	S06abc	7/15/2008	ND
805	Corridor	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
805	Corridor	Piping	Rain Water Leader	Transite	NF	ACM	VC	-	-	-
806	Corridor	Floor	Terrazzo	-	-	Non ACM	-	-	-	-



School Name Park Manor Public School Date Built: Original: 1972 Addition(s): N/A	Legend: HM - Homogenous Material - homogeneous with previously sampled material SL - Sample Location - Material Sampled VC - Visually Confirmed - Material not sampled, deemed ACM NF - Non-Friable F- Friable	Notes: All quantities provided on Figures, if known. Refer to the Asbestos Audit Update Report for condition of ACM and recommended actions. Dates provided in Material Description/Room Description columns indicates date of installation/renovation and confirms the finishes as non-ACM.
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WRDSB Fixed Reference Number	Room Description	Inspected Item	Inspected Material	Material Description	Friability	Asbestos Classification	Sample / Identification Summary	Sample ID	Sample Date	% Asbestos & Fibre Type
806	Corridor	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
806	Corridor	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
806	Corridor	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
806A	Corridor	Floor	Vinyl Floor Tile 12"x 12"	White/Grey Fleck	NF	ACM	HM	S10abc	7/15/2008	1.4% Chrysotile
806A	Corridor	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
806A	Corridor	Ceiling	Ceiling Tile 2 x 4	Long Fissure Random Pinhole	NF	ACM	HM	S04abc	7/15/2008	1.7% Chrysotile
806A	Corridor	Piping	Pipe Insulation	Fibreglass insulation	-	Non ACM	-	-	-	-
807	Corridor	Floor	Vinyl Floor Tile 12"x 12"	Brown Oatmeal	-	Non ACM	HM	S01abc	7/15/2008	ND
807	Corridor	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
807	Corridor	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
807	Corridor	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
808	Corridor	Floor	Vinyl Floor Tile 12"x 12"	White/Grey Fleck	-	Non ACM	SL	S03abc	7/15/2008	ND
808	Corridor	Wall	Concrete Block	-	-	Non ACM	-	-	-	-
808	Corridor	Wall	Drywall	Drywall Joint Compound	NF	ACM	HM	S02abcde	7/15/2008	2.0% Chrysotile
808	Corridor	Ceiling	Ceiling Tile 2 x 4	Short Fissure Random Pinhole 1996	-	Non ACM	-	-	-	-
Summary of Potential ACM Hidden or Not Assessed										
	Throughout Building	Not Inspected	Not Inspected	Wall Cavity Insulation						
	Throughout Building	Not Inspected	Not Inspected	Door Core Insulation						

FIGURES



Original Building - Doors Exterior Frames, Grey Sealant is ACM
 Original Building - Drywall Joint Compound is ACM

1972 ORIGINAL BUILDING

NOTES:
 ALL DRAWINGS TO BE REFERENCED WITH THE ASSOCIATED REPORT, LOCATIONS AND QUANTITIES ARE APPROXIMATE.
 ALL KNOWN OR SUSPECT ASBESTOS-CONTAINING MATERIALS AND/OR DESIGNATED MATERIALS ARE NOT DEPICTED ON THIS DRAWING. REFER TO THE REPORT FOR A COMPLETE LIST OF IDENTIFIED MATERIALS.
 THIS FIGURE IS COLOUR DEPENDENT. PHOTOCOPIES MAY ALTER INTERPRETATION OF THE FIGURE. ALWAYS REFER TO ORIGINAL DRAWINGS AND REPORT.

Legend
 13 Fixed Reference Number
 No Access

- Asbestos-Containing Materials (ACM):**
- Floor Tile
 - Rolled Flooring
 - Ceiling Tile
 - Friable Soft Textured Ceiling
 - Non-Friable Hard Textured Ceiling
 - Spray-On Fire Proofing
 - Transite (Asbestos Cement) Paneling
 - Duct Insulation
 - x2(1) Pipe Fitting Insulation w Quantity (Brackets Indicate # of Damaged Fittings)
 - Pipe Insulation (Vertical and Horizontal)
 - Transite (Asbestos Cement) Pipe (Vertical and Horizontal)
 - Duct Expansion Joints w Quantity (Brackets Indicate # of Damaged Joints)
 - ☁ Friable Debris



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PROJECT
 2019 ASBESTOS AUDIT UPDATE

DRAWING
 PARK MANOR PUBLIC SCHOOL
 LEVEL 1

Project Manager	A. Dennett	Date	February 2019
Design By	WRDSB	Project No.	34532-917
Drawn By	S. Nieboer	Drawing No.	1.0
Scale	N.T.S.		

TABLES

TABLE 1 - INTERNAL ABATEMENT MANAGEMENT


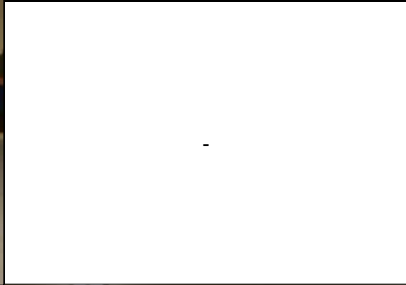






Park Manor Public School						
Material	WRDSB Fixed Reference Number	Material Description	Approximate Quantity	Photograph - Context	Photograph - Detail	Required Action
Asbestos Non-Friable	39	12"x12" Vinyl Floor Tile - White/Grey Fleck	<1 m ²			Repair/Removal in accordance with O. Reg. 278/05 as a Type 1 Operation
Asbestos Non-Friable	35	Drywall	<1 m ²			Repair/Removal in accordance with O. Reg. 278/05 < 1m ² as a Type 1 Operation - Hand tools only in conjunction with dust suppression
Asbestos Non-Friable	807	Drywall	<1 m ²			Repair/Removal in accordance with O. Reg. 278/05 < 1m ² as a Type 1 Operation - Hand tools only in conjunction with dust suppression
Asbestos Non-Friable	801	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²			Monitor Annually

Table 1 and 2 - Damaged Materials









TABLE 1 - INTERNAL ABATEMENT MANAGEMENT						
Park Manor Public School						
Material	WRDSB Fixed Reference Number	Material Description	Approximate Quantity	Photograph - Context	Photograph - Detail	Required Action
Asbestos Non-Friable	802	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²			Monitor Annually
Asbestos Non-Friable	13	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²			Removal in accordance with O. Reg. 278/05 <7.5 m ² as a Type1 Operation
Asbestos Non-Friable	11	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²			Monitor Annually
Asbestos Non-Friable	7	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²			Monitor Annually

Table 1 and 2 - Damaged Materials

TABLE 1 - INTERNAL ABATEMENT MANAGEMENT













Park Manor Public School						
Material	WRDSB Fixed Reference Number	Material Description	Approximate Quantity	Photograph - Context	Photograph - Detail	Required Action
Asbestos Non-Friable	7	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²			Removal in accordance with O. Reg. 278/05 <7.5 m ² as a Type1 Operation
Asbestos Non-Friable	5	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²			Monitor Annually
Asbestos Non-Friable	803	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²			Removal in accordance with O. Reg. 278/05 <7.5 m ² as a Type1 Operation
Asbestos Non-Friable	806A	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²			Monitor Annually

Table 1 and 2 - Damaged Materials

TABLE 1 - INTERNAL ABATEMENT MANAGEMENT

Park Manor Public School						
Material	WRDSB Fixed Reference Number	Material Description	Approximate Quantity	Photograph - Context	Photograph - Detail	Required Action
Asbestos Non-Friable	39	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²			Monitor Annually
Asbestos Non-Friable	4	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²		-	Monitor Annually
Asbestos Non-Friable	2	2' x 4' Ceiling Tiles - Long Fissure Random Pinhole	<1 m ²		-	Removal in accordance with O. Reg. 278/05 <7.5 m ² as a Type1 Operation

1) A copy of this report should be provided to all prospective contractors prior to tender or quotation, in accordance with Section 30 of the Occupational Health and Safety Act.
 2) Recommended actions are the minimum required actions, as prescribed by the appropriate Acts, regulations, guidelines, standards, codes and general best practice measures. The Contractor may choose to alter the approach and combine or break out sections of work. This is acceptable provided that the appropriate Acts, regulations, guidelines, standards and codes are followed and afford protection for the health and safety of workers, occupants and the public that is at least equal to the protection that would be provided by complying with the minimum requirements.
 3) All waste generated is subject to characterization and disposal in accordance with Ontario Regulation 347.

TABLE 2 - EXTERNAL ABATEMENT MANAGEMENT









Park Manor Public School						
Material	WRDSB Fixed Reference Number	Material Description	Approximate Quantity	Photograph - Context	Photograph - Detail	Required Action
Asbestos Friable	45	Insulation on Pipe Fitting	1			Removal/Repair in accordance with O. Reg. 278/05 as a Type 2 or Type 2 Glove Bag Operation
Asbestos Friable	45	Insulation on Pipe Fitting	1			Removal/Repair in accordance with O. Reg. 278/05 as a Type 2 or Type 2 Glove Bag Operation
Asbestos Friable	41	Insulation on Pipe Fitting	1			Removal/Repair in accordance with O. Reg. 278/05 as a Type 2 or Type 2 Glove Bag Operation
Asbestos Friable	37	Insulation on Pipe Fitting	1			Removal/Repair in accordance with O. Reg. 278/05 as a Type 2 or Type 2 Glove Bag Operation

Table 1 and 2 - Damaged Materials

TABLE 2 - EXTERNAL ABATEMENT MANAGEMENT

Park Manor Public School						
Material	WRDSB Fixed Reference Number	Material Description	Approximate Quantity	Photograph - Context	Photograph - Detail	Required Action
<p>1) A copy of this report should be provided to all prospective contractors prior to tender or quotation, in accordance with Section 30 of the Occupational Health and Safety Act.</p> <p>2) Recommended actions are the minimum required actions, as prescribed by the appropriate Acts, regulations, guidelines, standards, codes and general best practice measures. The Contractor may choose to alter the approach and combine or break out sections of work. This is acceptable provided that the appropriate Acts, regulations, guidelines, standards and codes are followed and afford protection for the health and safety of workers, occupants and the public that is at least equal to the protection that would be provided by complying with the minimum requirements.</p> <p>3) All waste generated is subject to characterization and disposal in accordance with Ontario Regulation 347.</p>						

TABLE 3: BULK ASBESTOS SAMPLING SUMMARY

Sample Number	Location	Material Description	Asbestos Content (%)	Fibre Type	Is Material ACM
2008 Asbestos Audit Update					
32523-PARKM-S01a	1024	12x12 Floor Tile - Brown Dense Fleck	ND	-	No
32523-PARKM-S01b			ND	-	No
32523-PARKM-S01c			ND	-	No
32523-PARKM-S02a	1025	Drywall Joint Compound	ND	-	No
32523-PARKM-S02b	1025		ND	-	No
32523-PARKM-S02c	1047		ND	-	No
32523-PARKM-S02d	1047		ND	-	No
32523-PARKM-S02e	1008		2	Chrysotile	Yes
32523-PARKM-S03a	1021	12x12 Floor Tile - White with Grey Fleck	Layer 1: ND	-	No
			Layer 2 (mastic): ND		No
32523-PARKM-S03b			Layer 1: ND	-	No
			Layer 2 (mastic): ND		No
32523-PARKM-S03c			Layer 1: ND	-	No
			Layer 2 (mastic): ND		No
32523-PARKM-S04a	1031	2x4 Ceiling Tile - Long Fissure Random Pinhole	1.7	Chrysotile	Yes
32523-PARKM-S04b			NA	-	Yes
32523-PARKM-S04c			NA	-	Yes
32523-PARKM-S05a	1031	12x12 Floor Tile - Beige Dense Fleck	Layer 1: ND	-	No
			Layer 2 (mastic): ND		No
32523-PARKM-S05b			Layer 1: ND	-	No
			Layer 2 (mastic): ND		No
32523-PARKM-S05c			Layer 1: ND	-	No
			Layer 2 (mastic): ND		No
32523-PARKM-S06a	1032	2x4 Ceiling Tile - Long Fissure Random Pinhole Textured	ND	-	No
32523-PARKM-S06b			ND	-	No
32523-PARKM-S06c			ND	-	No
32523-PARKM-S07a	1065	12x12 Floor Tile - Pink with Brown and White	Layer 1: 1.2	Chrysotile	Yes
			Layer 2 (mastic): ND		No
32523-PARKM-S07b			Layer 1: NA	-	Yes
			Layer 2 (mastic): ND	-	No
32523-PARKM-S07c			Layer 1: NA	-	Yes
	Layer 2 (mastic): ND	-	No		
32523-PARKM-S08a	1054	Plaster Texture Coat	0.5	Chrysotile	Yes
32523-PARKM-S08b			NA	-	Yes
32523-PARKM-S08c			NA	-	Yes
32523-PARKM-S09a	1062	12x12 Floor Tile - Light Beige and Brown	Layer 1: 1.2	Chrysotile	Yes
32523-PARKM-S09b			Layer 1: NA	-	Yes
			Layer 1: NA	-	Yes
32523-PARKM-S09c			Layer 2 (mastic): ND	-	No
32523-PARKM-S10a	1047	12x12 Floor Tile - White with Grey Fleck	1.4	Chrysotile	Yes
32523-PARKM-S10b			NA	-	Yes
32523-PARKM-S10c			NA	-	Yes
32523-PARKM-S11a	Gym Hall	12x12 Floor Tile - Green with Brown	1.2	Chrysotile	Yes
32523-PARKM-S11b	Gym Hall		NA	-	Yes
32523-PARKM-S11c			NA	-	Yes
32523-PARKM-S12a	1014	2x4 Ceiling Tile - Thick Fissure Random Pinhole	ND	-	No
32523-PARKM-S12b			ND	-	No
32523-PARKM-S12c			ND	-	No

Table 3 - Sample Summary Table

TABLE 3: BULK ASBESTOS SAMPLING SUMMARY					
Sample Number	Location	Material Description	Asbestos Content (%)	Fibre Type	Is Material ACM
2019 Asbestos Audit Update					
S01A	1007	Exterior Door Frame - Black	ND	-	No
S01B			ND	-	No
S01C			ND	-	No
S02A	1003	Interior Door Frame - White	ND	-	No
S02B			ND	-	No
S02C			ND	-	No
S03A	1059	Exterior Door Pane - Grey	0.5	Chrysotile	Yes
S03B			NA	-	Yes
S03C			NA	-	Yes
S04A	1063	Exterior Window Frame - Grey	ND	-	No
S04B			ND	-	No
S04C			ND	-	No
NA: Not Analyzed due to stop positive method ND: No asbestos fibres detected above the laboratory minimum detection limit					
A bulk material sample containing 0.5% or more asbestos therefore establishes that material as asbestos-containing. In accordance with Table 1 of O. Reg. 278/05, a minimum number of samples for the material to be classified as non asbestos. A homogeneous material is defined by O. Reg. 278/05 "as material that is uniform in colour and texture". Homogeneous samples are identified by an alphabetical suffix to sample names to represent multiple samples of a homogeneous material. When a homogeneous material is analysed it is determined to be asbestos-containing upon the first positive detection of asbestos equal to or greater than 0.5%. Subsequent samples of the same material are therefore not analysed. Some bulk samples are comprised of multiple layers and as such will require multiple analysis. In such cases each layer is isolated at the laboratory and analysed individually to determine asbestos content. As a result the laboratory may report additional samples beyond the submitted number of samples or include multiple analyses as subsets within a sample.					

Table 3 - Sample Summary Table

Certificate of Analysis

MTE Consultants Inc. (Kitchener)

520 Bingemans Centre Dr.
Kitchener, ON N2B 3X9
Attn: Aisling Dennett

Client PO:
Project: 34532-917 - Park Manor
Custody:

Report Date: 6-Feb-2019
Order Date: 30-Jan-2019

Order #: 1905210

This Certificate of Analysis contains analytical data applicable to the following samples as submitted :

Parcel ID	Client ID
1905210-01	S01A
1905210-02	S01B
1905210-03	S01C
1905210-04	S02A
1905210-05	S02B
1905210-06	S02C
1905210-07	S03A
1905210-08	S03B
1905210-09	S03C
1905210-10	S04A
1905210-11	S04B
1905210-12	S04C

Approved By:



Emma Diaz
Senior Analyst

Certificate of Analysis
 Client: MTE Consultants Inc. (Kitchener)
 Client PO:

Report Date: 06-Feb-2019
 Order Date: 30-Jan-2019

Project Description: 34532-917 - Park Manor

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Parcel ID	Sample Date	Colour	Description	Asbestos Detected	Material Identification	% Content
1905210-01	25-Jan-19	Black	Door Frame	No	Client ID: S01A Non-Fibers	100
1905210-02	25-Jan-19	Black	Door Frame	No	Client ID: S01B Non-Fibers	100
1905210-03	25-Jan-19	Black	Door Frame	No	Client ID: S01C Non-Fibers	100
1905210-04	25-Jan-19	White	Interior Door Frame	No	Client ID: S02A Non-Fibers	100
1905210-05	25-Jan-19	White	Interior Door Frame	No	Client ID: S02B Non-Fibers	100
1905210-06	25-Jan-19	White	Interior Door Frame	No	Client ID: S02C Non-Fibers	100
1905210-07	25-Jan-19	Grey	Interior Door Pane	Yes	Client ID: S03A Chrysotile Non-Fibers	[AS-PT] 0.5 99.5
1905210-08	25-Jan-19				Client ID: S03B not analyzed	
1905210-09	25-Jan-19				Client ID: S03C not analyzed	
1905210-10	25-Jan-19	Grey	Exterior Window Frame	No	Client ID: S04A Non-Fibers	100
1905210-11	25-Jan-19	Grey	Exterior Window Frame	No	Client ID: S04B Non-Fibers	100
1905210-12	25-Jan-19	Grey	Exterior Window Frame	No	Client ID: S04C Non-Fibers	100

Certificate of Analysis
Client: MTE Consultants Inc. (Kitchener)
Client PO:

Report Date: 06-Feb-2019
Order Date: 30-Jan-2019
Project Description: 34532-917 - Park Manor

** Analytes in bold indicate asbestos mineral content.

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	NVLAP Lab Code *	Analysis Date
Asbestos, PLM Visual Estimation	by EPA 600/R-93/116	1 - Mississauga	200863-0	1-Feb-19

* Reference to the NVLAP term does not permit the user of this report to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Qualifier Notes

Sample Qualifiers :

AS-PT: Asbestos quantitation by PLM Point Count method.

Work Order Revisions | Comments

None



Parcel ID: 1905210



Mississauga Location
00 Kitimat Road, Unit # 15
Mississauga, ON L5N 5M1

Chain of Custody
(Lab Use Only)

Page 1 of 1

Client Name: MTE Consultants Inc.	Project Reference: Project #34532-917 Park Manor	TAT:
Contact Name: Aisling Dennett	Quote #: 19-226 MTE Standing Offer	<input checked="" type="checkbox"/> Regular <input type="checkbox"/> 3 Day
Address: 520 Bingham Centre Drive, Kitchener	PO #: N/A	<input type="checkbox"/> 2 Day <input type="checkbox"/> 1 Day
	Email Address: adennett@mte85.com, snieboer@mte85.com	<input type="checkbox"/> Same Day
Telephone: 519-743-6500		Date Required

1905210

ASBESTOS ANALYSIS

Matrix: Air Other Regulatory Guideline: O. Reg. 278/05 Required Analyses: PCM PLM PLM 400PC PLM 1000PC Chatfield JTEM

Sample ID	Location	Matrix Description	Sampling Date	Air Volume (L)	Positive Stop? (Y/N)	Is the Sample Layered? (Y/N)	If layered, Describe Layer(s) to be Analyzed Separately* or Homogenize all **
1	S01ABC	1007 Exterior Door Frame - Black	1/25/2019	-	Y	N	N/A
2	S02ABC	1003 Interior Door Frame - White	1/25/2019	-	Y	N	N/A
3	S03ABC	1059 Exterior Door Pane - Grey	1/25/2019	-	Y	N	N/A
4	S04ABC	1063 Exterior Window Frame - Grey	1/25/2019	-	Y	N	N/A
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

* Each layer is charged as a separate analysis ** Homogenize = Sample is combined to a uniform mixture

Comments:

Method of Delivery

Percolation

Relinquished By (Sign): <i>SA</i>	Received at Depot:	Received at Lab: <i>[Signature]</i>	Verified By: <i>[Signature]</i>
Relinquished By (Print)& Date/Time: Steven Nieboer January 28, 2019	Date/Time:	Date/Time: <i>Jan 30-19 8:10</i>	Date/Time: <i>Jan 30-19 10:17</i>

SECTION 01 42 00 – REFERENCES

1.0 GENERAL

1.1. SECTION INCLUDES

- .1 References and standards.
- .2 Standards producing industry organizations and their addresses.

1.2. RELATED SECTIONS

- .1 Section 01 61 00 – Product Requirements.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3. REFERENCES

- .1 For Products or quality specified by association, trade, or other references or consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- .2 Conform to reference standard by Ontario Building Code except where a specific date is established or required by code.
- .3 Obtain copies of standards where required by product specification sections.
- .4 Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Consultant shall be altered from the Contract Documents by mention or inference otherwise, in any reference document.

1.4. STANDARDS

- .1 The following associations and organizations are cited in specification sections. Acronym, name, address, and Internet URL addresses are as follows:
- .2 Canadian Organizations:
 - .1 **ACEC** - Association of Consulting Engineers of Canada, 130 Albert Street, Suite 616, Ottawa, ON K1P 5G4; URL: <http://www.acec.ca>.
 - .2 **AWMAC** - Architectural Woodwork Manufacturers Association of Canada, 516-4 Street West, High River, AB T1V 1B6; URL: <http://www.awmac.com>.
 - .3 **Canada Green Building Council**, 330 - 55 rue Murray Street, Ottawa, ON. K1N5M3; Tel: 613-241-1184, Fax: 613-241-5750; URL: <http://www.cagbc.org>.
 - .4 **CCA** - Canadian Construction Association, 75 Albert St., Suite 400, Ottawa, ON K1P 5E7; URL: <http://www.cca-acc.com>.

- .5 **CCDC** – Canadian Construction Documents Committee, Refer to ACEC, CCA, CSC or RAIC; URL: <http://www.CCDC.org>.
- .6 **CGA** - Canadian Gas Association, 20 Eglinton Avenue West, Suite 1305, Toronto, ON M4R 1K8; URL: <http://www.cga.ca..>
- .7 **CGSB** - Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, QC K1A 0S5; URL: <http://w3.pwgsc.gc.ca/cgsb>.
- .8 **CISC** - Canadian Institute of Steel Construction, 201 Consumers Road, Suite 300, Willowdale, ON M2J 4G8; URL: <http://www.cisc-icca.ca>.
- .9 **CLA** - Canadian Lumbermen's Association, 27 Goulburn Avenue, Ottawa, ON K1N 8C7; URL: <http://www.cla-ca.ca>.
- .10 **CNLA** - Canadian Nursery Landscape Association, RR #4, Stn. Main, 7856 Fifth Street, Milton, ON L9T 2X8; URL: <http://www.canadanursery.com>.
- .11 **CRCA** - Canadian Roofing Contractors Association, 155 Queen Street, Suite 1300, Ottawa, ON K1P 6L1; URL: <http://www.roofingcanada.com>.
- .12 **CSA** - Canadian Standards Association International, 178 Rexdale Blvd., Toronto, ON M9W 1R3; URL: <http://www.csa-international.org>.
- .13 **CSC** - Construction Specifications Canada, 120 Carlton Street, Suite 312, Toronto, ON M5A 4K2; URL: <http://www.csc-dcc.ca>.
- .14 **CSDMA** - Canadian Steel Door Manufacturers Association, One Yonge Street, Suite 1801, Toronto, ON M5E 1W7; URL: <http://www.csdma.org>.
- .15 **CSPI** - Corrugated Steel Pipe Institute, 652 Bishop Street N, Unit 2A, Cambridge, ON N3H 4V6; URL: <http://www.cspi.ca>.
- .16 **CSSBI** - Canadian Sheet Steel Building Institute, 652 Bishop St. N., Unit 2A, Cambridge, ON N3H 4V6; URL: <http://www.cssbi.ca>.
- .17 **CUFCA** - Canadian Urethane Foam Contractor's Association, Box 3214, Winnipeg, MB R3C 4E7; URL: <http://www.cufca.ca>.
- .18 **CWC** - Canadian Wood Council, 1400 Blair Place, Suite 210, Ottawa, ON. K1J 9B8; URL: <http://www.cwc.ca>.
- .19 **EC** - Environment Canada, Conservation and Protection, Inquiry Centre, 351 St. Joseph Blvd, Hull, QC KIA 0H3; URL: <http://www.ec.gc.ca>.
- .20 **EFC** - Electro Federation of Canada, 5800 Explorer Drive, Suite 200, Mississauga, ON L4W 5K9; URL: <http://www.electrofed.com>.
- .21 **MPI** - The Master Painters Institute, 4090 Graveley Street, Burnaby, BC V5C 3T6; URL: <http://www.paintinfo.com>.

- .22 **NABA** - National Air Barrier Association, PO Box 2747, Winnipeg, MB R3C 4E7; URL: <http://www.naba.ca>.
- .23 **NLGA** - National Lumber Grades Authority, 406-First Capital Place, 960 Quayside Drive, New Westminster, BC V3M 6G2; URL: <http://www.nlga.org>.
- .24 **NRC** - National Research Council, Building M-58, 1200 Montreal Road, Ottawa, ON K1A 0R6; URL: <http://www.nrc.gc.ca>.
- .25 **QPL** - Qualification Program List, c/o Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, QC K1A 1G6; URL: <http://www.pwgsc.gc.ca/cgsb>.
- .26 **RAIC** - Royal Architectural Institute of Canada, 55 Murray Street, Suite 330, Ottawa, ON K1N 5M3; URL: <http://www.raic.org>.
- .27 **SCC** - Standards Council of Canada, 270 Albert Street, Suite 2000, Ottawa, ON K1P 6N7; URL: <http://www.scc.ca>.
- .28 **TTMAC** - Terrazzo, Tile and Marble Association of Canada, 30 Capston Gate, Unit 5 Concord, ON L4K 3E8; URL: <http://www.ttmac.com>.
- .29 **ULC** - Underwriters' Laboratories of Canada, 7 Crouse Road, Toronto, ON M1R 3A9; URL: <http://www.ulc.ca>.
- .3 USA Organizations:
 - .1 **AA** - Aluminum Association, 900 19th Street N.W., Washington, DC 20006; URL: <http://www.aluminum.org>.
 - .2 **AASHTO** - American Association of State Highway and Transportation Officials, 444 N Capitol Street N.W., Suite 249, Washington, DC 20001; URL: <http://www.aashto.org>.
 - .3 **AHA** - American Hardboard Association, 1210W Northwest Hwy, Palatine, IL 60067; URL: <http://www.hardboard.org>.
 - .4 **AITC** - American Institute of Timber Construction, 7012 S. Revere Parkway, Suite 140, Englewood, CO 80112; URL: <http://www.aitc-glulam.org>.
 - .5 **AMCA** - Air Movement and Control Association Inc., 30 West University Drive, Arlington Heights, IL 60004-1893; URL: <http://www.amca.org>.
 - .6 **ANSI** - American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036; URL: <http://www.ansi.org>.
 - .7 **APA** - The Engineered Wood Association, P.O. Box 11700, Tacoma, WA 98411-0700; URL: <http://www.apawood.org>.
 - .8 **API** - American Petroleum Institute, 1220 L St. Northwest, Washington, DC 20005-4070; URL: <http://www.api.org>.
 - .9 **ARI** - Air Conditioning and Refrigeration Institute, 4100 N Fairfax Drive, Suite 200, Arlington, VA 22203; URL: <http://www.ari.org>.

- .10 **ASHRAE** - American Society of Heating, Refrigeration and Air-Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, GA 30329; URL: <http://www.ashrae.org>.
- .11 **ASME** - American Society of Mechanical Engineers, ASME Headquarters, 3 Park Avenue, New York, NY 10016-5990; URL: <http://www.asme.org>.
- .12 **ASTM International**, 100 Barr Harbor Drive West, Conshohocken, PA 19428-2959; URL: <http://www.astm.org>.
- .13 **AWCI** - Association of the Wall and Ceiling Industries International, 803 West Broad Street, Suite 600 , Falls Church, VA 22046; URL: <http://www.awci.org>.
- .14 **AWPA** - American Wire Producer's Association, 801 N Fairfax Street, Suite 211, Alexandria, VA 22314-1757; URL: <http://www.awpa.org>.
- .15 **AWPA** - American Wood Preservers' Association, P.O. Box 5690, Granbury TX 76049-0690; URL: <http://www.awpa.com>
- .16 **AWS** - American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126; URL: <http://www.amweld.org>.
- .17 **AWWA** - American Water Works Association, 6666 W. Quincy Avenue, Denver, CO 80235; URL: <http://www.awwa.org>.
- .18 **EIMA** - EIFS Industry Manufacturer's Association, 3000 Corporate Center Drive, Suite 270, Morrow, GA 30260; URL: <http://www.eima.com>.
- .19 **ISAP** - International Society for Asphalt Paving, 400 Selby Avenue, Suite 1, St. Paul, MN 55102; URL: <http://www.asphalt.org>.
- .20 **IEEE** - Institute of Electrical and Electronics Engineers, IEE Corporate Office, 3 Park Avenue, 17th Floor, New York, NY 10016-5997; URL: <http://www.ieee.org>
- .21 **MSS** - Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, VA 22180-4602; URL: <http://www.mss-hq.com>.
- .22 **NAAMM** - National Association of Architectural Metal Manufacturers, 8 South Michigan Avenue, Suite 1000, Chicago, IL 60603; URL: <http://www.naamm.org>.
- .23 **NEMA** - National Electrical Manufacturers Association, 1300 N 17th Street, Suite 1847, Rosslyn, VA 22209; URL: <http://www.nema.org>.
- .24 **NFPA** - National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101 Quincy, MA 02269-9101; URL: <http://www.nfpa.org>.
- .25 **NFSA** - National Fire Sprinkler Association, P.O. Box 1000, Patterson, NY 12563; URL: <http://www.nfsa.org>.

- .26 **NHLA** - National Hardwood Lumber Association, 6830 Raleigh-La Grange Road, Memphis, TN 38184-0518; URL: <http://www.natlhardwood.org>.
- .27 **NSPE** - National Society of Professional Engineers, 1420 King Street, Alexandria, VA 22314-2794; URL: <http://www.nspe.org>.
- .28 **PCI** - Prestressed Concrete Institute, 209 W. Jackson Blvd., Suite 500, Chicago, IL 60606-6938; URL: <http://www.pci.org>.
- .29 **PEI** - Porcelain Enamel Institute, PO Box 920220, Norcross, GA 30010; URL: <http://www.porecelainenamel.com>.
- .30 **SSPC** - The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh, PA 15222-4656; URL: <http://www.sspc.org>.
- .31 **TPI** - Truss Plate Institute, 583 D'Onofrio Drive, Suite 200, Madison, WI 53719; URL: <http://www.tpinst.org>.
- .32 **UL** - Underwriters' Laboratories, 333 Pfingsten Road, Northbrook, IL60062-2096; URL: <http://www.ul.com>.

END OF SECTION

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SECTION 01 45 00 – QUALITY CONTROL

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 21 00 - Allowances.
- .2 Section 01 78 10 – Closeout Submittals and Requirements
- .3 Section 01 79 00 – Demonstration and Training
- .4 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. REFERENCES

- .1 **ISO/IEC** 17025-2005 - General Requirements for the Competence of Testing and Calibration Laboratories.
- .2 **SCC** (Standards Council of Canada).

1.3. INSPECTION BY AUTHORITY

- .1 Allow Authorities Having Jurisdiction access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection whenever portions of the Work are designated for special tests, inspections or approvals, either when described in the Contract Documents or when required by law in the Place of the Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

1.4. REVIEW BY CONSULTANT

- .1 Consultant may order any part of the Work to be reviewed or inspected if Work is suspected to be not in accordance with Contract Documents.
- .2 If, upon review such work is found not in accordance with Contract Documents, correct such Work and pay cost of additional review and correction.
- .3 If such Work is found in accordance with Contract Documents, The owner will pay cost of review and replacement.

1.5. INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection and Testing Agencies will be engaged by Contractor for purpose of inspecting and testing portions of Work.
- .2 The Board may, at their discretion, request that the Consultant direct the Contractor to engage independent inspecting and or testing agencies to review or test the Work.
- .3 Allocate Costs for inspections and testing to Section 01 21 00.
- .4 Provide equipment required for executing inspection and testing by appointed agencies.
- .5 Employment of inspection and testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .6 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and testing to ascertain full degree of defect. Correct defect and irregularities as advised by Consultant at no cost to Owner. Contractor shall pay costs directly to the inspection agency for retesting and re-inspection.

1.6. ACCESS TO WORK

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

1.7. CONTRACTOR RESPONSIBILITIES

- .1 Notify appropriate agency minimum 48 hours in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.8. DUTIES & AUTHORITY OF TESTING AGENCY

- .1 Testing agency is expected to do the following:
 - .1 Act in a professional and unprejudiced basis and carry out inspection and testing functions to establish compliance with requirements of Contract Documents.
 - .2 Check work as it progresses and prepare reports stating results of tests and conditions of work and state in each report whether specimens

tested conform to requirements of Contract Documents, specifically noting deviations.

- .3 Distribute reports as follows
 - .1 Consultant
 - .2 Owner
 - .3 Contractor
- .2 Testing agency is not authorized to amend or release any requirements of Contract Documents, nor to approve or accept any portion of work.

1.9. REJECTED WORK

- .1 The Contractor shall remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Consultant as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, the Owner may choose to accept the condition. The difference in value between Work performed and that called for by Contract Documents shall be deducted from the Contract value via Change Order. The amount of this change shall be determined by Consultant. The Contractor shall warrant the work performed for the time period specified as if it were performed in accordance with the Contract Documents.

1.10. TESTING OF EXCAVATION & BACK FILL

- .1 The Consultant must approve all Sample and fill tests prior to purchase.
- .2 In coordination with the Consultant and Contractor, inspect and test backfill and fill to ensure the degree of compaction specified has been obtained.
- .3 Inspect excavation at required levels in regard to bearing values for footings, foundations and floor slabs.
- .4 Authorization and calculation of extra excavation work, if required, due to unsatisfactory bearing shall be adjusted by Unit Price.

1.11. CONCRETE STRENGTH TESTS

- .1 Review the proposed concrete mix design and check test if considered necessary.
- .2 Obtain representative samples of fresh concrete for each mix design of concrete placed in any one day as directed by the Consultant.

- .3 Make standard slump tests.
- .4 Mould three (3) standard 150mm diameter cylindrical test specimens from each sampling of fresh concrete. Store specimens as per best practice while they are on the site. Cure all cylinders in the laboratory under standard moisture and temperature conditions. Compression test one of the cylinders at 7 days and the remaining two at 28 days after sampling. Each concrete cylinder test report shall contain the specific location of concrete represented by sample, design strength, aggregate size, admixtures used, date, hour and temperature at time of sampling, percentage air content, unit weight and test strength of cylinder.
- .5 When concrete is placed under the conditions of "Cold Weather Requirements" make one additional cylinder; store it in a heated enclosure for 24 hours and then store it on the job site in a place protected from disturbance and off the ground. Compressive test this cylinder 7 days after sampling.
- .6 Determine the air content of air entrained standard weight concrete.
- .7 Determine the air content and unit weight of light weight concrete by the volumetric method.
- .8 Additional testing required because of changes in materials or proportions of the mix requested by the Contractor as well as any extra testing of concrete or materials occasioned by their failure to meet specification requirements or testing of the structure or performance of the structure, including load testing, shall be carried out at the Contractor's expense.

1.12. INSPECTION OF STRUCTURAL STEEL

- .1 Ensure all steel has mill test reports that comply with the Specification prior to purchase.
- .2 Inspect fabrication of steel in plant.
- .3 Inspect erection work at site including fit-up, placing, plumbing, levelling, temporary bracing, field cutting and alterations.
- .4 Shop and field inspect welded and bolted connections and painting.
- .5 High strength bolts - the installation and testing of bolts shall conform to the requirements of CSA S16-1969. Check one representative connection in ten by torque testing every bolt, and check each bolt in every connection with a tap of hammer for soundness. Enforce requirements of connection type.
- .6 Examine visually all welded joints for inclusions, porosity, lack of fusion penetration or even contour, undercuts and cracks. Root passes shall be checked for penetration and cracks from the back of the joint. Any suspect welds shall be checked ultrasonically.

1.13. INSPECTION OF METAL DECK

- .1 Check deck for gauge, type and protective coating thickness to ensure compliance with Specification.
- .2 Inspect erection work at the site including anchorage.

1.14. INSPECTION AND TESTING OF PAVING

- .1 Testing shall be carried out in three stages as described below by means of sufficient site visits to ensure satisfactory results but in no case less three site visits.
- .2 Test within 16 hours from time called to do so by Contractor, since paving is a critical item at the end of the project.
- .3 Stage One:
 - .1 Visual inspection and compaction tests of subsoil.
- .4 Stage Two:
 - .1 Inspection of granular sub-base (after each layer is placed or after the last layer is placed and compacted).
 - .2 On site density tests.
 - .3 Verify thickness of various levels. (Minimum of 4 checks shall be done on thickness in a paved area of 250m² or less, and 1 additional check for each additional 250m² or part thereof).
 - .4 Laboratory tests: moisture content and grading of materials.
- .5 Stage Three:
 - .1 Inspection of asphalt installation.
 - .2 Checking of thickness and density of material and checking suitability of equipment used.
- .6 Standard Proctor Test shall be carried out for all projects.
- .7 Further, grain size analysis and Marshall test shall be carried out if visual inspection is not satisfactory or, if there is reason to suspect materials supplied are not acceptable.
- .8 All laboratory tests shall be performed according to A.S.T.M. methods, latest revisions
- .9 Paving Contractor shall obtain from their supplier grading tables of materials used and submit them to the testing laboratory for approval. The paving contractor shall ensure material delivered complies with grading tables.
- .10 Be responsible for all approvals given to Paving Contractor. At completion of paving project, inform Consultant all tests were performed according to the Specifications and the Contractor's performance has been approved.

- .11 The Consultant will not entertain any credits for work either not performed or incorrectly performed by the contractor. If thicknesses or consistencies of sub-base are not as specified, or if asphaltic material is not as specified, then the Contractor shall remove same at their expense and provide proper specified materials.

1.15. BUILDING THERMOGRAPHIC SCAN

- .1 Upon completion of the Work, the Consultant and/or Owner may arrange for an independent agency to carry out a thermographic scan of the building to determine acceptability of thermal performance of the building envelope.
- .2 Consultant, prior to start of construction work, will designate a sample area of the building to include a portion of exterior wall and roof.
- .3 Consultant will implement a special inspection program for this sample area to be carried out as construction progresses. Contractor shall not cover any completed work until notifying Consultant and receiving acceptance of completed work. Contractor shall remove and replace any work which is installed in contravention of this requirement.
- .4 Results of thermographic scan of entire building will be evaluated and compared to those of the sample area to determine acceptance or rejection of any part of the building envelope.
- .5 Contractor shall carry out remedial work as required to bring quality of any rejected portion of the building envelope to that of the sample area. Contractor shall pay for costs of any follow-up thermographic scans required to determine acceptability of remedial work. This procedure shall be repeated until all parts of the building envelope have been accepted.

1.16. TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as may be requested.
- .2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work shall be appraised by Consultant and may be authorized as recoverable.

1.17. MOCK-UP

- .1 Prepare mock-up for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.
- .2 Prepare mock-ups for Consultants review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

- .3 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .4 If requested, Consultant will assist in preparing a schedule fixing dates for preparation.
- .5 Remove mock-up at conclusion of Work or when acceptable to Consultant. Repair any damage and clean-up at place of mock-up.
- .6 Approved mock-up may remain as part of Work.

1.18. EQUIPMENT AND SYSTEMS

- .1 Submit adjustment and balancing reports for mechanical and electrical systems to the consultant.
- .2 Refer to Sections 01.78.10 and 01.79.00 for definitive requirements.

END OF SECTION

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SECTION 01 51 00 – TEMPORARY UTILITIES

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 52 00 - Construction Facilities.
- .2 Section 01 53 00 - Temporary Construction.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. INSTALLATION AND REMOVAL

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Location of temporary facilities shall be subject to Consultant's approval.
- .3 Salvage and assist in recycling products for potential reuse wherever possible.
- .4 Remove temporary facilities from site when directed by consultant.

1.3. DEWATERING

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water. Provide necessary pumps (including spare pumps) and temporary drainage for keeping the Work free of water throughout construction period. Locate sumps away from foundation elements. Control grading around excavation to prevent surface water from draining into excavation and from damaging adjoining property.

1.4. WATER SUPPLY

- .1 Provide continuous supply of potable water for construction use until such time as permanent municipal water supply is available.
- .2 Hose extensions to be provided by subcontractors requiring them.
- .3 For New Builds arrange for connection with appropriate utility company and pay all costs for installation, maintenance, removal and usage costs until occupancy has been achieved.
- .4 For Additions and renovations the contractor can use existing Board service unless noted otherwise.

1.5. TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including unit rental costs, maintenance.

- .2 Provide temporary heating fuel, if not already available on site, until such time as a permanent natural gas line is installed, and thereafter fuel costs shall be borne by the Board. The Contractor shall provide all connections and piping between the permanent fuel source and the heating appliance(s).
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum:
 - .1 10 degrees C in areas where construction is in progress, until takeover by Board. Contractor to ensure temporary enclosures remain sealed and penetrations are repaired or closed in a timely fashion.
 - .2 16 degrees C in areas where finishes are in progress.
 - .3 16 degrees C in building once it is enclosed.
 - .4 Refer to other Sections for intermittent heating requirements up to 21 degrees C. Provide insulated tarp enclosures for openings as required to enclose the building after completion of main building shell components and roof.
 - .5 If the Contractor fails to ensure the temporary enclosures remained sealed (including temp doors when not in use) the Consultant and or the Board shall require the contractor to pay 40% of that months usage charge
- .5 Use forced hot air heaters. Open-flame type heaters or salamanders are not permitted. Ventilate direct fired heating units to the outside.
- .6 Uniformly distribute heat to avoid hot and cold areas and to prevent excessive drying.
- .7 Early heating of the building shell will be required to expedite interior finishing to meet the project schedule.
- .8 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.

- .4 Ventilate storage spaces containing hazardous or volatile materials.
- .5 Ventilate temporary sanitary facilities.
- .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .7 Provide minimum 1 air change per hour for enclosed areas receiving architectural finishes.
- .8 Do not allow excessive build-up of moisture inside building.
- .9 The permanent mechanical systems for the new building, when installed in safe operating conditions, may be used for temporary heating or cooling if approved in writing by the Consultant, without penalty to the warranty.
- .10 Follow the requirements of "Temporary Use of New Permanent Services and Equipment" if the permanent heating system installed under the contract is intended to be used for temporary heating during the construction.
- .11 Provide competent persons to operate and maintain permanent systems for duration of temporary use period.
- .12 Perform required repairs and maintenance immediately after each inspection. Pay for operating costs. Upon termination of temporary use period, services and equipment shall be inspected, tested, adjusted, fitters replaced, balanced, cleaned and lubricated.
- .13 Permanent services and equipment shall be turned over to Owner in new and perfect operating condition.
- .14 Use of permanent systems and equipment as temporary facilities shall not affect the guarantee conditions and guarantee period for such systems and equipment. Make due allowance to ensure Owner will receive full benefits of equipment manufacturer's warranty from the date of Substantial Performance.
- .15 Ensure date of Substantial Performance of the Work and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Consultant.
- .16 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .17 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.6. TEMPORARY POWER AND LIGHT

- .1 Provide temporary electrical service and system including lighting and power system for use by all Sections.
- .2 Contractor will provide a source for, and pay the costs of temporary power during construction for temporary lighting and operating of power tools until such time as permanent source is available.
- .3 Contractor to ensure that the use of power from a source provided by the Board shall not exceed the capacity of the current use required for the operation of any existing facility.
- .4 Install and maintain temporary electrical service and systems in accordance with Construction Safety Association's "Temporary Wiring Standards on Construction Sites", the Ontario Electrical Code and other authorities having jurisdiction.
- .5 Provide at least one temporary panel on each floor with service capacity suitable for construction requirements and to authorities and utilities approval.
- .6 Provide temporary wiring with lighting to all areas of each floor to provide adequate lighting.
 - .1 Lighting levels must be maintained at a minimum of 10 foot candles, or to suit the particular location or operation, whichever is greater.
 - .2 Do not use materials of the temporary service in permanent installation.
 - .3 Increase lighting levels equivalent to the final requirements when finishing operations are underway.
- .7 Extension cords, lights, etc., required by various subcontractors and run from above outlet positions will be supplied and maintained by the party or parties requiring same.
- .8 Follow requirements of "Temporary Use of New Permanent Services and Equipment" if electrical power and lighting systems installed under the contract are intended to be used for temporary electricity and lighting during the construction.
- .9 Electrical power and lighting systems installed under this contract can be used for construction provided damages are made good and all lamps that have been used for more than two months are replaced with new lamps.
- .10 For New Builds arrange for connection with appropriate utility company and pay all costs for installation, maintenance, removal and usage costs until occupancy has been achieved.
- .11 For Additions and renovations the contractor can use existing Board service unless noted otherwise.
- .12 Provide and pay for temporary power for electric cranes and other equipment requiring temporary power in excess of above noted requirements.

1.7. TEMPORARY COMMUNICATION FACILITIES

- .1 Contractor to provide and pay for temporary Phone, e-mail and printer hook up, for the duration of contract until completion for use by the contractor.
- .2 The site superintendent is to have e-mail access and a printer on site.

END OF SECTION

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SECTION 01 53 00 – TEMPORARY CONSTRUCTION FACILITIES

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 51 00 - Temporary Utilities.
- .2 Section 01 35 23 – Health and Safety
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. INSTALLATION AND REMOVAL

- .1 Provide temporary construction facilities in order to execute work expeditiously.
- .2 Remove temporary facilities from site when directed by Consultant.

1.3. PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

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

1.4. PROTECTION OF SURROUNDING WORK

- .1 Provide protection for finished and partially finished Work from damage.
- .2 Provide necessary cover and protection.
- .3 Be responsible for damage incurred due to lack of or improper or inappropriate protection.

1.5. ROOF AND STRUCTURE PROTECTION

- .1 Ensure no part of Work or existing structures are subjected to a load, which will endanger its safety or will cause permanent deformation.
- .2 The Contractor when indicated by the Board Contact or Consultant shall provide roof protection. Ensure all precautions are taken to avoid liability for roof damage.
- .3 Typical roof protection shall consist of a layer of 1inch rigid foam insulation set directly on the roof surface and a layer of 19 mm (3/4 inch) plywood in all places under scaffold legs, ladder legs and in areas of foot traffic or falling debris.

1.6. WORK SITE ENCLOSURE & SAFETY BARRIERS

- .1 Erect and maintain for the duration of the work:

- .1 a minimum 1800 mm high chain link fence or self-supporting, heavy duty, interconnected fence panels (commonly referred to as Insta-fence) for a temporary site enclosure (hoarding) completely around perimeter of work site,
 - .2 any temporary posts shall be completely removed by the contractor prior to occupancy,
 - .3 under no circumstance shall t-bar posts be used on board property
 - .4 any additional safety devices including full hoarding as required and noted on the drawings, to protect the students, staff, public and private property from injury and damage,
 - .5 any additional requirements as regulated by authorities having jurisdiction, local by-laws and zoning.
- .2 The Contractor is to assume full responsibility for any injury or damage caused due to failure to comply with Paragraph 1 above.
 - .3 Any hazardous conditions identified outside of the main fenced area will be barricaded with a fence complying to the above.
 - .4 Provide lockable truck entrance gate/gates and at least one (1) pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys with restricted availability, in the project office.
 - .5 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.
 - .6 Provide barriers around trees and plants designated to remain.
 - .7 Protect from damage by equipment and construction procedures.

1.7. TREE PROTECTION

- .1 Protect all existing trees to remain from damage during construction period. Make good, at Contractor's expense, trees damaged during construction.
- .2 Confine movement of heavy equipment, storage of same, and storage of materials to a predetermined area. Do not store materials or place equipment over root systems of any existing trees to remain.
- .3 Install fencing or approved equal at limits of drip line of existing trees to remain unless directed otherwise. Where this case is not practical, and only if approved by the Consultant, the trunks shall be protected with an approved tree guard.
- .4 No rigging cables shall be wrapped around or installed in trees. Do not flush concrete trucks or cement mixing machines over root systems or near trees. Flush concrete trucks or cement mixing machines in areas approved by Consultant.

- .5 Areas where root systems of trees are exposed directly adjacent to a structure will be backfilled with good loam only.
- .6 Whenever excavating is required within branch spread of trees that are to remain, the contractor shall contact the consultant for direction prior to the start of work.
- .7 If any existing tree to remain is injured and does not survive the following year, it will, as determined by the Board, be removed in its entirety and be replaced with a tree of similar size and value, as directed by the Consultant.
- .8 Should the destroyed tree be of such a size or shape that it cannot be feasibly replaced, the Contractor shall compensate the Owner for the minimum sum of five thousand dollars (\$5,000.00) per destroyed tree.

1.8. GUARD RAILS AND BARRIERS

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.
- .2 Erect and maintain for the duration of the Work, safety devices and barricades including hoarding, as required, to protect the staff, students, public and private property, from injury and damage.
- .3 The Contractor is to ensure that all requirements from authorities having jurisdiction and all requirements from the Owner are met.
- .4 The Contractor is to assume full responsibility for any damage caused due to his failure to comply with paragraph 2 above.
- .5 Hazardous conditions on the exterior shall be fenced.

1.9. WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure.

1.10. DUST TIGHT BARRIERS

- .1 Provide dust tight barriers and screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.
- .3 Where required adjust air handling units to eliminate migration of dust.

1.11. SCAFFOLDING

- .1 Erect scaffolding independent of walls and use in such a manner limiting interference with other work. When not in use, move scaffolding as necessary to permit installation of other work. Construct and maintain scaffolding in a rigid, secure and safe manner. Remove it promptly when no longer required. Protect surface on which scaffolding is bearing.

1.12. SHORING, BRACING, PILING

- .1 Provide shoring, bracing, piling, sheeting and sheet piling and underpinning required to support soil banks, existing work and property in accordance with Construction Safety Act and other applicable regulations. Maintain shoring until building is strong enough and sufficiently braced to withstand pressure of backfilling. Make construction aids free of permanent work so they may be removed entirely when no longer required, without damaging the Work. Locate construction aids so adequate room is left for damp-proofing foundation walls, laying substructure drainage and other work.
- .2 Shoring and false work over one tier in height shall be designed and shall bear the stamp of a registered professional engineer, having experience in this field.

1.13. HOISTING

- .1 Provide, operate and maintain services required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.
- .2 Machinery shall be operated by qualified operator.

1.14. OVERHEAD LIFTING

- .1 Any condition requiring the use of a crane or lifting device over a Board structure must follow the requirements of Health and Safety Section 01 35 23, Paragraph 1.15 Overhead Lifting.

1.15. ELEVATORS/LIFTS

- .1 When elevators/lifts are to be used by construction personnel, provide protective coverings for finish surfaces of elevator cabs and entrances.
- .2 Co-ordinate use of elevator cabs with Consultant and the Board.

1.16. USE OF THE WORK

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with Products.

- .2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.17. CONSTRUCTION PARKING

- .1 Construction personnel vehicle parking, to be confined to the work site enclosure, or.
- .2 Parking will be permitted on site only where and if it does not disrupt the employees of the place of work as directed by the Board
- .3 Permission to park vehicles on site does not imply any liability or responsibility for safe keeping of vehicles and contents thereof by the School Board.

1.18. ACCESS TO SITE

- .1 Provide and maintain adequate access to project site.
- .2 Build and maintain temporary roads where necessary and provide snow removal within the area of work, and access to the work, during period of Work. The area shall be restored to the satisfaction of the Board at the completion of the project.
- .3 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.
- .4 Clean roadways and taxi areas where used by Contractor's equipment.

1.19. SECURITY

- .1 The Contractor shall ensure the security of the work site, contents, and built structures for the duration of the project.
- .2 The Contractor shall be responsible to provide and pay for security personnel to guard site and contents of site after working hours and during holidays as required.
- .3 Notify the Board of the use of security guards or systems.
- .4 The Board shall not be responsible for the loss, theft, or vandalism.

1.20. OFFICES

- .1 Provide and maintain, until completion of Contract, for Contractor's use, a temporary office, large enough to accommodate site administrative activities and site meetings, complete with light, heat, air conditioning, ventilation, table and chairs. Do not store materials in office area; keep clean and tidy.
- .2 Provide a clearly marked and fully stocked first-aid case in a readily available location.

- .3 Subcontractors may provide their own offices as necessary. Direct location of these offices.

1.21. EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds and platforms for storage of tools, equipment and materials.
- .2 Review storage areas on site with the Consultant. Store materials and equipment to ensure preservation of quality of product and fitness for the Work. Store materials and equipment on wooden platforms or other hard, clean surfaces, raised above the ground or in water tight storage sheds of sufficient size for storage of materials and equipment which might be damaged by storage in open. Locate stored materials and equipment to facilitate prompt inspection.
- .3 Store packaged materials and equipment undamaged, in their original wrappings or containers, with manufacture's labels and seals intact.
- .4 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.
- .5 Storage sheds required by subcontractors shall be provided by them.

1.22. SANITARY FACILITIES

- .1 Provide weatherproof temporary toilet/sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Service temporary toilet/sanitary facilities as required by authorities but not less than weekly.
- .3 Post notices and take such precautions as required by local health authorities.
- .4 The use of existing washroom facilities is not allowed unless specifically approved by the Board. The Contractor will be required to clean and maintain the existing washrooms to Board standards.
- .5 Except where connected to municipal sewer system, periodically remove wastes from Site.
- .6 Keep toilet/sanitary facilities clean and sanitary and protect from freezing.
- .7 Keep sanitary facilities clean and fully stocked with the necessary supplies at all times.

END OF SECTION

SECTION 01 61 00 – PRODUCT REQUIREMENTS

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 This section describes requirements applicable to all Sections within Divisions 02 to 49.
- .2 Section 01 31 00 – Project Managing and Coordination

1.2. TERMINOLOGY

- .1 New: Produced from new materials.
- .2 Renewed: Produced or rejuvenated from an existing material to like-new condition to serve a new or existing service.
- .3 Defective: A condition determined exclusively by the Consultant.

1.3. PRODUCT QUALITY

- .1 The term 'new' in the following paragraph does not exclude re-manufactured products that have some or all of the materials recycled from other sources. Preference in recycling is for post-consumer recycled materials.
- .2 Products, materials, equipment, parts or assemblies (referred to as Products) incorporated in Work:
- .3 New Product, not damaged or defective, of best quality (compatible with specification requirements) for purpose intended. If requested, provide evidence as to type, source and quality of Products provided.
- .4 Defective Products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.
- .5 Should any dispute arise as to quality or fitness of Products, decision rests strictly with Consultant.
- .6 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

1.4. AVAILABILITY

- .1 Immediately upon receipt of Boards Purchase Order, review Product delivery requirements and anticipate foreseeable supply delays for any items.
- .2 Immediately upon receipt of Boards Purchase Order the Contractor shall issue Purchase Orders and or Contracts to all Sub-trades. Provide proof to

the Consultant and the Board within 3 days. The Sub-Contractors shall identify in writing any delivery issues within 14 days of receiving the Contractors purchase order or contract. The Schedule noted in 01-31 00 1.7.1 shall incorporate all deliveries and installation.

- .3 If delays in supply of Products are foreseeable, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .4 In event of failure to notify Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available Products of similar character, at no increase in Contract Price or Contract Time.

1.5. STORAGE AND PROTECTION

- .1 Store and protect Products in accordance with manufacturers' written instructions.
- .2 Store with seals and labels intact and legible.
- .3 Store sensitive Products in weather tight, climate controlled, enclosures in an environment favourable to Product.
- .4 For exterior storage of fabricated Products, place on sloped supports above ground.
- .5 Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of Products.
- .6 Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- .7 Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- .8 Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

1.6. TRANSPORTATION AND HANDLING

- .1 Transport and handle Products in accordance with manufacturer's written instructions.
- .2 Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.
- .3 Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.
- .4 Suitably pack, crate and protect products during transportation to site to preserve their quality and fitness for the purpose intended.

- .5 Store products in original, undamaged condition with manufacturer's labels and seals intact until they are being incorporated into completed work.
- .6 Protect materials from damage by extreme temperatures or exposure to the weather.

1.7. EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to the owner.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

1.8. MANUFACTURER'S WRITTEN INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect Products to manufacturer's written instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
- .2 Notify Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant may establish course of action.
- .3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Consultant to require removal and re-installation at no increase in Contract Price or Contract Time.

1.9. QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Consultant if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Consultant and or Board reserves right to require dismissal from site any workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant, whose decision is final.
- .4 Products, materials, systems and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the applicable manufacturer's printed directions.

- .5 Where specified requirements are in conflict with manufacturer's written directions, follow manufacturer's directions. Where specified requirements are more stringent than manufacturer's directions, comply with specified requirements.

1.10. COORDINATION

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.
- .3 Contractor is responsible to ensure suppliers or distributors of materials specified or alternatives accepted, which he intends to use, have materials with original schedule, and similarly it shall be the responsibility of all subcontractors and suppliers to so inform the Contractor.
- .4 Contractor shall contact Consultant immediately upon receipt of information indicating materials or items, will not be available on time, in accordance with the latest approved schedule, and similarly it shall be the responsibility of all subcontractors and suppliers to so inform the Contractor.
- .5 The above, in no way releases the Contractor, or their subcontractors and suppliers of their responsibility for ensuring timely ordering of materials and items required, including the necessary expediting, to complete the Work as scheduled in accordance with the Contract Documents including temp accommodations and or materials to ensure occupancy date is achieved.

1.11. CONCEALMENT

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform Consultant if there is interference. Install as directed by Consultant at no additional cost to the Board.

1.12. REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.13. LOCATION OF FIXTURES

- .1 Inform Consultant of conflicting installation. Install as directed.

1.14. FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use Type 304 or 316 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.15. PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of any part of the Project.
- .2 Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of Consultant.

END OF SECTION

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SECTION 01 70 00 – EXAMINATION AND PREPARATION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. REFERENCES

- .1 Owner's identification of existing survey control points and property limits.

1.3. SUBMITTALS

- .1 Submit name and address of Surveyor to Consultant.
- .2 On request of Consultant, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying that elevations and locations of completed Work conforms with Contract Documents.

1.4. QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practise in the Place of the Work.

1.5. SURVEY REFERENCE POINTS

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

1.6. SURVEY REQUIREMENTS

- .1 Establish existing and new permanent bench marks on site, referenced to established bench marks by survey control points.
- .2 Record locations, with horizontal and vertical data in Project Record Documents.
- .3 Establish lines and levels, locate and lay out, by instrumentation.

- .4 Establish pipe invert elevations.
- .5 Stake batter boards
- .6 Establish foundation and floor elevations.
- .7 Establish lines and levels for mechanical and electrical work.

1.7. SUBSURFACE CONDITIONS

- .1 Promptly notify Consultant in writing if discovered surface or subsurface conditions at Place of Work differ materially from those indicated in Contract Documents.
- .2 Advise the Consultant of a reasonable assumption of probable conditions when determined.
- .3 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work.

1.8. EXAMINATION

- .1 The Contractor is expected to be totally familiar with site conditions and shall assume full responsibility for the cost involved in repairing any damage to the building, site and services, city property, adjacent buildings, etc., during general construction, regardless of the extent of the damage.
- .2 Inspect existing conditions, including elements or adjacent Work subject to irregularities, damage, movement, including Work during cutting and patching.
- .3 The Contractor shall provide all equipment necessary to make a full and detailed site evaluation. This shall include but not be limited to ladders, flashlights and hand tools.
- .4 The Contractor expressly agrees that conditions above existing suspended acoustic ceilings, but below fixed structure, unless obscured by an additional ceiling above, shall be considered exposed conditions for the purposes of making findings under the provisions of the Contract. There shall be no claims for extra costs for extra Work in these areas.
- .5 After uncovering, inspect conditions affecting performance of the Work.
- .6 Beginning of cutting or patching means acceptance of existing conditions.

1.9. PREPARATION

- .1 Provide supports to assure structural integrity of surroundings; provide 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.

1.10. EXISTING SERVICES

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

1.11. LOCATION OF EQUIPMENT AND FIXTURES

- .1 Inform Consultant of conflicting installations, install as directed.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Consultant of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Consultant.

1.12. SURVEY RECORD

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of maintained, re-routed and abandoned service lines.

END OF SECTION

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SECTION 01 73 30 – EXECUTION AND CUTTING AND PATCHING

2.0 GENERAL

2.1. RELATED SECTIONS

- .1 Section 01 32 00 - Construction Progress Documentation: Submittals and scheduling.
- .2 Section 01 61 00 - Product Requirements.
- .3 Section 01 70 00 – Examination and Preparation
- .4 Individual Product Specification Sections:
 - .1 Cutting and patching incidental to work of the section.
 - .2 Advance notification to other sections of openings required in Work of those sections.

2.2. 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 element.
 - .3 Efficiency, maintenance, or safety of any operational element.
 - .4 Visual qualities of sight exposed elements.
 - .5 Work of Owner or separate contractor.
- .2 Include in request:
 - .1 Identification of Project.
 - .2 Location and description of affected Work.
 - .3 Necessity for cutting or alteration.
 - .4 Description of proposed Work and Products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on work of Owner or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

2.3. TOLERANCES

- .1 Monitor fabrication and installation tolerance control of Products to produce acceptable Work.
- .2 Do not permit tolerances to accumulate beyond effective or practical limits.
- .3 Comply with manufacturers' tolerances. In case of conflict between manufacturers' tolerances and Contract Documents, request clarification from Consultant before proceeding.

- .4 Adjust Products to appropriate dimensions; position and confirm tolerance acceptability, before permanently securing Products in place.

3.0 PRODUCTS

3.1. MATERIALS

- .1 Primary Products: Those required for original installation.
- .2 Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 33 00.

4.0 EXECUTION

4.1. EXAMINATION

- .1 Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering existing Work, assess conditions affecting performance of work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.

4.2. PREPARATION

- .1 Provide temporary supports to ensure structural integrity of the Work. Provide 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.
- .3 Maintain excavations free of water.

4.3. CUTTING

- .1 Execute cutting and fitting as needed to complete the Work. Prior to any cutting and or coring of concrete floors the contractor shall confirm the area is free of services or rebar. Notify the Consultant of any interferences.
- .2 Uncover work to install improperly sequenced work.
- .3 Remove and replace defective or non-conforming work.
- .4 Remove samples of installed work for testing for Hazardous materials.
- .5 Provide openings in the Work for penetration of mechanical and electrical work.
- .6 Employ experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- .7 Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

- .8 Do all cutting, patching and making good, to leave a finished condition and to make the several parts of the work come together properly. Coordinate work to keep cutting and patching to a minimum.
- .9 Make cuts with clean, true, smooth edges. Fit unit to tolerance established by test standard practice for applicable work. Make patches invisible in final assembly.
- .10 Cutting shall be done in a manner to keep patching to minimum. Obtain Consultant's approval of method to be used to conceal new mechanical and electrical services before beginning cutting. Chasing of concrete surfaces is not permitted.
- .11 Cutting or coring of any structural concrete is to be reviewed and approved by the Consultant.
- .12 Do not endanger any work by cutting, digging or otherwise altering, and do not cut nor alter any load bearing element without written authorization by Consultant. Provide bracing, shoring and temporary supports as required to keep construction safely supported at all times
- .13 Any cost caused by omission or ill-timed work shall be borne by party responsible therefore.
- .14 Regardless of which Section of work is responsible for any portion of cutting and patching, in each case tradesmen qualified in work being cut and patched shall be employed to ensure it is correctly done.

4.4. PATCHING

- .1 Execute patching to complement adjacent Work.
- .2 Fit Products together to integrate with other Work.
- .3 Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- .4 Employ original installer to perform patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.
- .5 Restore work with new Products in accordance with requirements of Contract Documents.
- .6 Fit work with adequate support to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .7 At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with firestop material.
- .8 Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
- .9 Complete and tightly fit all construction to pipes, ducts and conduits which pass through construction to completely prevent the passage of air.

- .10 Patching and making good shall be done by trade specialists in material to be treated, and shall be made undetectable in finished work when viewed from distance of 1.5m under normal lighting.

END OF SECTION

SECTION 01 74 00 – CLEANING AND WASTE MANAGEMENT

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Common Work by All Trades
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.
- .3 Conduct cleaning and disposal operations to comply with local ordinances and environmental protection legislation.
- .4 Store volatile wastes in covered metal containers, and remove from premises at end of each working day.
- .5 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

2.0 PRODUCTS

2.1. CLEANING PRODUCTS

- .1 Cleaning Agents and Materials: Low VOC content wherever possible. The Consultant and the Board shall be notified prior to use of any exception.

3.0 EXECUTION

3.1. CLEANING DURING CONSTRUCTION

- .1 Maintain the Work in tidy condition, free from accumulation of waste products and debris, other than that caused by the Owner or other Contractors.
- .2 Remove waste material and debris from the work areas and deposit in waste container at the end of each working day.
- .3 Vacuum clean interior areas prior to start of finishing work. Maintain areas free of dust and other contaminants during finishing operations.
- .4 Individual Subcontractors are responsible for the daily clean-up and removal of debris related to, or generated by, their own work. The overall responsibility for project cleanliness rests with the Contractor.
- .5 The Contractor shall be responsible for snow removal within the construction area.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Wherever possible recycle materials
- .8 Containers:

- .1 Provide adequate number and sizes of on-site garbage and recycling containers within designated work site as required for collection of waste materials and debris on a daily basis.
- .2 Provide additional waste containers when extent of work warrants.
- .3 Provide and use clearly marked, separate bins for recycling.
- .9 Dispose of waste materials and debris at registered waste disposal and recycling facility.
- .10 Remove oily rags, waste and other hazardous substances from premises at close of each day, or more often when required.
- .11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

3.2. WASTE MANAGEMENT

- .1 Audit, separate and dispose of construction waste generated by new construction or by demolition of existing structures in whole or in part, in accordance with Ontario Regulations 102/94 and 103/94 made under the Environmental Protection Act.
- .2 Containers:
 - .1 Provide adequate number and sizes of on-site garbage and recycling containers within designated work site as required for collection of waste materials and debris on a daily basis.
 - .2 Provide additional waste containers when extent of work warrants.
 - .3 Provide and use clearly marked, separate bins for recycling.
- .3 Fires, and burning of rubbish or waste on site is strictly prohibited.
- .4 Burying of rubbish or waste materials on site is strictly prohibited.
- .5 Disposal of waste or volatile materials such as mineral spirits, oil, gasoline or paint thinner into ground, waterways, or sewer systems is prohibited.
- .6 Empty waste containers on a regular basis to prevent contamination of site and adjacent properties by wind-blown dust or debris

3.3. PREPARATION FOR FINAL CLEANING

- .1 Prior to final cleaning the General Contractor shall:
 - .1 remove all surplus products, tools, construction machinery and equipment not required for the performance of remaining work, and thereafter remove any remaining materials, equipment, waste and debris,
 - .2 replace all filters installed on any equipment in operation in the area of work,

- .3 remove all paint spots or overspray from all affected surfaces, and

3.4. FINAL CLEANING PRIOR TO ACCEPTANCE: INTERIOR

- .1 Prior to applying for Substantial Performance of the Work, or, prior to Owner occupancy of the building or portion of the building affected by the Work, whichever comes first, conduct full and complete final cleaning operations for the areas to be occupied.
- .2 Final cleaning operations shall be performed by an experienced professional cleaning company, possessing equipment and personnel sufficient to perform full building cleaning operations. Contractors "broom cleaning" is not acceptable as a "Final Clean". The cleaning contractor shall:
 - .1 clean interiors of all millwork and surfaces of any furniture and equipment present,
 - .2 use only cleaning materials recommended by the manufacturer of the surface to be cleaned,
 - .3 remove all stains, spots, scuff marks, dirt, dust, remaining labels, adhesives or other surface imperfections,
 - .4 clean and polish all glass and mirrors and remove remaining manufacturer's and safety "X" labels,
 - .5 clean and polish all finished metal surfaces such as enamelled or stainless steel, chrome, aluminum, brass, and bronze,
 - .6 clean and polish all vitreous surfaces such as plumbing fixtures, ceramic tile, porcelain enamel, or other such materials,
 - .7 clean all ceramic tile surfaces in accordance with the manufacturer's instructions,
 - .8 vacuum, clean and dust behind grilles, louvres and screens,
 - .9 steam clean all unprotected carpets immediately prior occupancy by Owner, and
 - .10 clean all equipment and fixtures to a sanitary condition.
- .3 For any areas to be occupied after the owner's initial occupancy, provide full cleaning operations as outlined above prior to turning over to owner,
- .4 The Board's supplies and equipment must not be used for any cleaning operations including, but not limited to: garbage cans, mops, brooms, rags, ladders, chemicals etc.

3.5. FINAL CLEANING PRIOR TO ACCEPTANCE: EXTERIOR

- .1 For areas effected by construction final exterior cleaning operations shall be performed by the General Contractor or competent sub-contractor. Contractor's "broom cleaning" only is not acceptable.

- .2 Final exterior cleaning shall include:
 - .1 broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds,
 - .2 remove dirt and other disfiguration from exterior surfaces,
 - .3 sweep and wash clean paved areas,
 - .4 replace filters of mechanical equipment for all equipment that was in use during construction,
 - .5 clean all roofs, gutters, downspouts, areaways, drywells, and drainage systems,
 - .6 remove debris and surplus materials from crawl areas and other accessible concealed spaces.
 - .7 remove overspray

END OF SECTION

SECTION 01 78 10 – CLOSEOUT SUBMITTALS AND REQUIREMENTS

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 78 10 – Appendix 1 and 2 – WRDSB Warranty Card

1.2. TAKE-OVER PROCEDURES

- .1 Take over procedures will be in strict accordance with the requirements as set out in this Section.

1.3. SUBSTANTIAL PERFORMANCE

- .1 Prior to requesting a Substantial Performance deficiency inspection submit 2 hard copies, 1 digital copy of the Operating and Maintenance Manuals for Consultants approval.
- .2 Application for Substantial Performance must include.
 - .1 One (1) electronic copy of inspection and acceptance certificates required from regulatory agencies, including but not limited to.
 - .1 Certificates of Approval of the Work by the local Building Department.
 - .2 Electrical Inspection Certificate of Inspection.
 - .3 Fire Alarm Verification Certificate.
- .3 Advise Consultant in writing, when project has been substantially completed. If Consultant agrees this stage has been reached, the Consultant shall prepare a complete list of deficiencies and submit copies of this list to Contractor and the Board.

1.4. COMMENCEMENT OF LIEN PERIODS

- .1 The date of publication of the Certificate of Substantial Performance of the Work, provided to the contractor by the Consultant, shall be the date for commencement of the lien period.

1.5. TOTAL PERFORMANCE

- .1 Prior to requesting a final inspection submit written certificate that the following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents and is ready for final inspection
 - .2 Defects have been corrected and deficiencies have been completed.

- .3 Equipment and systems have been tested and are fully operational. Submit two copies of the balancing reports
- .4 Certificates required by the contractor have been submitted.
- .5 Operation of systems have been demonstrated to Owner's personnel.
- .6 Submit Record drawings.
- .7 Submit maintenance materials.
- .8 Provide certified site survey
- .2 When items noted above are completed, request final inspection of Work by consultant, and building inspector. If Work is deemed incomplete by Consultant, complete outstanding items and request re-inspection.

1.6. PAYMENT OF SUBSTANTIAL PERFORMANCE HOLDBACK

- .1 Prior to the release of lien holdback provide one copy of the following by the Contractor and each subcontractor:
 - .1 Statutory Declaration or Declaration of Last supply
 - .2 Workplace Safety and Insurance Board "Certificate of Clearance".
- .2 The Contractor shall submit an application for payment of the holdback amount.
- .3 After the receipt of an application for payment which will include a Statutory Declaration and WSIB Clearance from the, the Consultant will issue a certificate for payment of the holdback amount.

1.7. FINAL PAYMENT

- .1 When the Contractor considers final deficiencies and defects have been corrected and it appears requirements of Contract have been completed, make application for final payment.
- .2 When the Consultant finds the Contractor's application for final payment valid, the Consultant will issue a final certificate of payment
- .3 The Board reserves the right to charge the Contractor for school access card(s) that have not been returned.
- .4 The cost to reprogram or replace the card(s) access system is estimated at \$50.00 (fifty dollars) for each card issued, \$30.00 (thirty dollars) for each keybox key, plus \$35.00 (thirty five dollars) administration fee.

1.8. CLOSEOUT SUBMITTALS

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products and submit to Consultant for review.
- .2 Copy will be returned to contractor with Consultant's comments.
- .3 Revise content of documents as required prior to final submittal.

- .4 Two (2) weeks prior to Substantial Performance of the Work, submit to the Consultant, the final copies of operating and maintenance manuals.
- .5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .6 If requested, furnish evidence as to type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .8 Pay costs of transportation.

1.9. OPERATION AND MAINTENANCE MANUAL FORMAT

- .1 Provide two copies of operating and maintenance data, prepared on 215 X 280mm sheets in printed or typewritten form, contained in 3-ring binders with soft vinyl covers for materials and equipment which require special maintenance or operating procedures.
- .2 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder at the front of each volume.
- .3 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .4 Arrange content by the divisions of the specifications under Section numbers and sequence of Table of Contents.
- .5 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .6 Include the following in each manual:
 - .1 Complete list of subcontractors and suppliers, their addresses and telephone numbers. Provide 24 hour emergency telephone number for such subcontractors as Plumbing, Electrical, Sprinklers, Fire System, Heating, etc.
 - .2 Specified warranties for contractor, each subcontractor and supplier.
 - .3 WRDSB Warranty Card
 - .4 Copy of finish hardware list, complete with all amendments and revisions and lock manufacturer's descriptive and service literature.
 - .5 Schedule of paints and coatings. Include sufficient explanation to fully identify each surface with the applicable paint or coating used. Enclose copy of colour schedule.
 - .6 Maintenance instructions for finished surfaces.
 - .7 Brochures, cuts of equipment and fixtures.
 - .8 Operating and maintenance instructions for equipment.

- .9 Submit copies of letters from manufacturers of equipment and systems indicating their technical representatives have inspected and tested systems and are satisfied with methods of installation, connection and operations. These letters shall state names of persons present at testing, methods used and list of functions performed.
- .10 Submit one complete set of reviewed shop drawings of architectural, structural, mechanical and electrical items, folded to 215 x 280mm size, contained in heavy duty manila envelopes, numbered and labelled. Follow specification format with no more than one Section per envelope, hard copy and PDF.
- .11 Relevant certificates issued by authorities having jurisdiction
- .12 Computer disc or flash drive with all the above documentation in PDF format

1.10. RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings, and within the Project Manual.
- .2 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information.
- .3 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately recorded.
- .4 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: Maintain warranties, test reports and samples required by individual specifications sections.

1.11. RECORD (AS-BUILT) DOCUMENTS AND SAMPLES

- .1 Store AS-BUILT documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .2 Label AS-BUILT documents and file in accordance with section number listings in List of Contents of the Project Manual. Label each document AS-BUILT DOCUMENTS in neat, large, printed letters.
- .3 Maintain AS-BUILT documents in clean, dry and legible condition. Do not use as-built documents for construction purposes.
- .4 Keep as-built documents and samples available for inspection by Consultant.

1.12. RECORD DRAWINGS

- .1 Prior to Substantial Performance of the Work, update the marked up information from the AS-BUILT documents to a master set of drawing.
- .2 Submit one set of completed AS-BUILT documents to the Consultant for review.
- .3 Documents will be returned to contractor with Consultant's comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 After the review is completed resubmit to the Consultant for Consultant to produce electronic record drawings for the owner to use.

1.13. SPARE PARTS

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.
- .4 Obtain receipt for delivered products and submit prior to final payment.

1.14. REPLACEMENT (MAINTENANCE) MATERIALS

- .1 Deliver to site, unload and store where directed, replacement (maintenance) materials as required elsewhere in these Specifications. Obtain signed receipt from Owner's Representative for delivered materials and include copy of receipt in Operation and Maintenance manuals.
- .2 Package materials so they are protected from damage and loss of essential properties.
- .3 Label packaged materials for proper identification of contents.

1.15. SPECIAL TOOLS

- .1 Provide special tools, in quantities specified in individual specification section.

- .2 Provide items with tags identifying their associated function and equipment.
- .3 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual

1.16. FINAL SITE SURVEY

- .1 Submit final site survey certificate in accordance with Section 01 70 00, certifying that elevations and locations of completed Work are in conformance Contract Documents.

1.17. WARRANTIES AND BONDS

- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined. The date of Substantial Performance of the Work shall be the date for commencement of the warranty period.
- .4 Verify that documents are in proper form, contain full information, and are notarized.
- .5 Co-execute submittals when required.
- .6 Retain warranties and bonds until time specified for submittals.

END OF SECTION

SECTION 01 78 40 – MAINTENANCE REQUIREMENTS

1.0 GENERAL

1.1. SECTION INCLUDES

- .1 Equipment and systems.
- .2 Materials and finishes.
- .3 Spare parts
- .4 Maintenance manuals.
- .5 Special tools.
- .6 Storage, handling and protection.
- .7 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. RELATED SECTIONS

- .1 Section 01 45 00 - Quality Control.
- .2 Section 01 78 40 – Maintenance Requirements.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3. EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.

- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide coordination Drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00.
- .15 Additional requirements: As specified in individual specification sections.

2.0 PRODUCTS

2.1. MATERIALS AND FINISH

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Building Envelope: include copies of drawings of building envelope components, illustrating the interface with similar or dissimilar items to provide an effective air, vapour and thermal barrier between indoor and outdoor environments. Include an outline of requirements for regular inspections and for regular maintenance to ensure that on-going performance of the building envelope will meet the initial building envelope criteria.
- .5 Additional Requirements: as specified in individual specifications sections.

2.2. SPARE PARTS

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.
- .4 Obtain receipt for delivered products and submit prior to final payment.

2.3. MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.
- .4 Obtain receipt for delivered products and submit prior to final payment.

2.4. SPECIAL TOOLS

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.

3.0 EXECUTION

3.1. DELIVERY TO SITE

- .1 Deliver to place of work and store.
- .2 General Contractor to receive and acknowledge delivery from contractors and sub-contractors of all parts and materials assembled for maintenance requirements. Provide a summary inventory list to the Consultant and/or the Board after all materials are gathered and verification of location. Signatures of receipt will not be accepted from anyone except the General Contractor's representative.

3.2. STORAGE, HANDLING AND PROTECTION

- .1 Consult with the Board to determine location for storage.
- .2 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .3 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .4 Store components subject to damage from weather in weatherproof enclosures.
- .5 Store paints and freezable materials in a heated and ventilated room.
- .6 Remove and replace damaged products at own expense and to satisfaction of Consultant.

END OF SECTION

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SECTION 01 79 00 – DEMONSTRATION AND TRAINING

1.0 GENERAL

1.1. SECTION INCLUDES

- .1 Procedures for demonstration and instruction of Products, equipment and systems to Owner's personnel.
- .2 Seminars and demonstrations.

1.2. RELATED SECTIONS

- .1 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3. DESCRIPTION

- .1 At Substantial Performance, at a time acceptable to Owner and Consultant, but not before operations and maintenance manual have been reviewed and accepted by the consultant; contractor shall give a complete demonstration in the presence of consultant; Sub-consultants, Owner and Owner's personnel of operation and maintenance of systems and equipment once they are 100% complete.
- .2 Owner will provide list of personnel to receive instructions and will coordinate their attendance at agreed-upon times.

1.4. COMPONENT DEMONSTRATION

- .1 Manufacturer to provide authorized representative to demonstrate operation of equipment and systems.
- .2 Instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.

1.5. SUBMITTALS

- .1 Submit schedule of time and date for demonstration of each item of equipment and each system one (1) week prior to designated dates, for Consultant's approval.
- .2 Submit reports within forty eight (48) after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 Give time and date of each demonstration, with list of persons present.

1.6. CONDITIONS FOR DEMONSTRATIONS

- .1 Equipment has been inspected and put into operation in accordance with manufacturer's instructions and contract requirements.
- .2 Testing, adjusting, and balancing have been performed in accordance with manufacturer's instructions and contract requirements, and equipment and systems are fully operational.
- .3 Provide information packages as required for use in demonstrations and instructions.

2.0 PRODUCTS

2.1. NOT USED

- .1 Not used.

3.0 EXECUTION

3.1. PREPARATION

- .1 Verify that suitable conditions for demonstration and instructions are available.
- .2 Verify that designated personnel are present.
- .3 Prepare agendas and outlines.
- .4 Establish seminar organization.
- .5 Explain component design and operational philosophy and strategy.
- .6 Develop equipment presentations.
- .7 Present system demonstrations.
- .8 Accept and respond to seminar and demonstration questions with appropriate answers.

3.2. PREPARATION OF AGENDAS AND OUTLINES

- .1 Prepare agendas and outlines including the following:
 - .1 Equipment and systems to be included in seminar presentations.
 - .2 Name of companies and representatives presenting at seminars.
 - .3 Outline of each seminar's content.
 - .4 Time and date allocated to each system and item of equipment.
 - .5 Provide separate agenda for each system.

3.3. SEMINAR ORGANIZATION

- .1 Coordinate content and presentations for seminars.
- .2 Coordinate individual presentations and ensure representatives scheduled to present at seminars are in attendance.

- .3 Arrange for presentation leaders familiar with the design, operation, maintenance and troubleshooting of the equipment and systems. Where a single person is not familiar with all aspects of the equipment or system, arrange for specialists familiar with each aspect.
- .4 Coordinate proposed dates for seminars with Owner and select mutually agreeable dates.

3.4. EXPLANATION OF DESIGN STRATEGY

- .1 Explain design philosophy of each system. Include following information:
 - .1 An overview of how system is intended to operate.
 - .2 Description of design parameters, constraints and operational requirements.
 - .3 Description of system operation strategies.
 - .4 Information to help in identifying and troubleshooting system problems.

3.5. DEMONSTRATION AND INSTRUCTIONS

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment.
- .2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .3 Instruct personnel on control and maintenance of sensory equipment and operational equipment associated with maintaining energy efficiency and longevity of service.
- .4 Review contents of manual in detail to explain all aspects of operation and maintenance.
- .5 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

END OF SECTION

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PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Demolition and removal of selected non-structural portions of building.
 - .2 Salvage:
 - .1 Salvaging of designated items for reuse by *Owner*.
 - .3 Removal of surplus materials from the *Place of the Work*.
 - .4 Related mechanical and electrical work and demolition requirements are covered under Mechanical and Electrical Divisions.

1.2 Administrative Requirements

- .1 Pre-demolition meeting:
 - .1 Schedule a pre-demolition meeting following the procedures specified for pre-installation meetings.
 - .2 Review existing conditions at the *Place of the Work* thoroughly to establish full extent of items to be removed, including footings, foundations, slabs, toppings, secondary floor finishes, and structures and items to remain. Commencement of demolition work will be considered to be acceptance of existing conditions at the *Place of the Work* and removal of such items.
 - .3 Examine adjacent properties to determine extent of protection required.

1.3 Submittals

- .1 Submit required submittals.
- .2 Special procedures submittals:
 - .1 Existing conditions documentation:
 - .1 Document existing conditions of adjoining construction and site improvements, including pre-existing damage to finish surfaces that might be misconstrued as damage caused by demolition operations.
 - .1 Photographic documentation:
 - .1 Submit photograph of each window to be replaced from interior and exterior.
 - .2 Submit 4 photographs of each wall within the main office space to be impacted by the Work.
 - .3 Submit 1 photograph of each partition to remain within each classroom impacted by the Work.
 - .2 Submit existing conditions documentation before demolition work begins.

1.4 Quality Assurance

- .1 Qualifications:

Demolition

- .1 Installers / applicators / erectors: the work of this section shall be executed by a *Subcontractor* able to deploy adequate equipment and skilled personnel to complete work expediently in an efficient and orderly manner.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that utilities have been disconnected and capped.
- .2 Observe existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- .3 When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to *Consultant*.
- .4 Survey of existing conditions: Record existing conditions by use of photographs.

3.2 Utility Services and Mechanical / Electrical Systems

- .1 Refer to Mechanical and Electrical Divisions.

3.3 Selective Demolition, General

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

Demolition

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

3.4 Salvage

- .1 Remove and store items indicated or directed for salvage. Remove, handle and transport such items to storage area designated, to an area within the *Place of the Work* designated by *Consultant*, or to an area away from the *Place of the Work* as directed by the *Consultant*. Perform such work to prevent damage to the items during removal and in storage.
- .2 Remove and store indicated items for future use by *Owner*. Remove, handle and transport such items to storage area indicated in the *Contract Documents* or to an area within the *Place of the Work* designated by *Consultant*. Perform such work carefully and with diligence to prevent any damage to the items during removal and in storage.
- .3 Salvage the existing wood classroom doors to be removed and also a palette of bricks from the new/ modified exterior openings.

3.5 Protection

- .1 *Provide* temporary weather enclosures.
- .2 Prevent debris from obstructing active services and drainage systems.
- .3 Protect work to remain against damage. Repair or replace damaged work at no additional cost to the *Owner*.
- .4 Ensure electrical items including, but not limited to camera, aiphone and key card fob to remain in place are protected from damage during the *Work*.

END OF SECTION

Masonry Procedures

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Masonry procedures for masonry work.
 - .2 Salvage an existing masonry.

1.2 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in masonry assemblies.

1.3 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors: *Provide* work of this section, executed by competent installers in application of *Products*, systems and assemblies specified and with approval of *Product* manufacturers.

1.4 Delivery, Storage, and Handling

- .1 Deliver materials to the *Place of the Work* in dry condition.
- .2 Keep materials dry until use.
- .3 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

1.5 Field Conditions

- .1 Cold weather construction requirements:
 - .1 Comply with requirements of CAN/CSA A371-14, and as follows:

Air Temperature, °C	General requirements during construction
0 to 4	Sand or mixing water shall be heated to a minimum of 20°C and a maximum of 70°C.
-4 to 0	Sand and mixing water shall be heated to a minimum of 20°C and a maximum of 70°C.
-7 to -4	(1) Sand and mixing water shall be heated to a minimum of 20°C and a maximum of 70°C. (2) Source heat shall be provided on both sides of the walls under construction. (3) Windbreaks shall be employed when the wind speed exceeds 25 km/h.
-7 and below	(1) Sand and mixing water shall be heated to a minimum of 20°C and a maximum of 70°C. (2) Enclosures and supplementary heat shall be provided to maintain an air temperature above 0°C. (3) The temperature of the unit when laid shall be not less than 7°C.

- .2 Grout shall be placed in masonry at a minimum temperature of 20°C and a maximum temperature of 50°C.
- .3 Mortar temperature shall not exceed 50°C to avoid flash set.

Masonry Procedures

- .4 Maintain dry beds for masonry and use dry masonry units only. Do not wet masonry units in winter.
- .2 Cold weather protection requirements:
 - .1 Comply with requirements of CAN/CSA A371-14, and provide protection requirements for completed masonry or sections not in progress shall be as follows:

Mean daily air temperature, °C	Protection
0 to 4	Masonry shall be protected from rain or snow for 48 h
-4 to 0	Masonry shall be completely covered for 48 h
-7 to -4	Masonry shall be completely covered with insulating blankets for 48 h
-7 and below	The masonry temperature shall be maintained above 0 °C for 48 h by enclosure and supplementary heat

- .3 Hot weather construction requirements:
 - .1 Comply with requirements of CAN/CSA A371-14, and as follows:
 - .1 The spreading of mortar beds shall be limited to 1.2 m, and the masonry units shall be set within 1 minute of spreading the mortar, when the air temperature is above:
 - .1 38°C; or
 - .2 32°C, with a wind velocity greater than 13 km/h.
 - .2 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36 for a period of 2 years.

PART 2 - PRODUCTS

2.1 Materials

- .1 Mortar and grout for masonry: in accordance with Section 04 05 13.
- .2 Masonry reinforcement and connectors: in accordance with Section 04 05 19.
- .3 Concrete masonry units: in accordance with Section 04 22 00.

PART 3- EXECUTION

3.1 Workmanship

- .1 Build masonry plumb, level, and true to line, with vertical joints in proper alignment. Lay masonry to tolerances specified in CAN/CSA A371-14.
- .2 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
- .3 Masonry mortar and grout work: CAN/CSA A179-14 except where specified otherwise.
- .4 Masonry work: CSA S304-14, CAN/CSA A370-14 and CAN/CSA A371-14 except where specified otherwise.

Masonry Procedures

3.2 Salvage

- .1 Salvage a palette of existing bricks from the new openings for reuse as required to make good new/modified openings.

3.3 General Erection Tolerances

- .1 Lay masonry units with required mortar joint thickness specified below, not to exceed 12.7 mm (1/2").
- .2 Construction tolerances:
 - .1 Exterior mortar joint dimensions to match existing.
 - .2 Maximum variation from plumb in vertical lines and surfaces of columns, walls and arrises:
 - .1 6.4 mm (1/4") in 3 m (10').
 - .2 9.6 mm (3/8") in a storey height not to exceed 6 m (20').
 - .3 12.7 mm (1/2") in 12 m (40') or more.
 - .3 Maximum variation from plumb for external corners, expansion joints and other conspicuous lines:
 - .1 6.4 mm (1/4") in any story or 6 m (20') maximum.
 - .2 12.7 mm (1/2") in 12 m (40') or more.
 - .4 Maximum variation from level of grades for exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines:
 - .1 6.4 mm (1/4") in any bay or 6 m (20').
 - .2 12.7 mm (1/2") in 12 m (40') or more.
 - .5 Maximum variation from plan location of related portions of columns, walls and partitions:
 - .1 12.7 mm (1/2") in any bay or 6 m (20').
 - .2 19 mm (3/4") in 12 m (40') or more.
 - .6 Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from dimensions shown on drawings:
 - .1 Minus 6.4 mm (1/4").
 - .2 Plus 12.7 mm (1/2").
 - .7 Where masonry surfaces serves as substrate for thin-set tile and direct applied and insulated finish coatings, build to tolerance of 3.2 mm in 2440 mm (1/8" in any 8') under a straight edge.

3.4 Laying Masonry Units

- .1 Coursing design:
 - .1 Concrete masonry units:
 - .1 To match existing.
- .2 Installation and materials shall meet or exceed that of accepted samples.
- .3 Units shall be cut only upon acceptance of *Consultant*. Walls are to be laid-up with full size masonry units.

Masonry Procedures

- .4 Keep cavity space at cavity and/or veneer walls clear of mortar droppings and debris.
- .5 Remove loose and foreign materials from supporting bed surfaces to ensure bonding.
- .6 Do not tooth at wall terminations. Rake back 1/2 unit length where stop-off occurs in horizontal run of masonry.
- .7 At openings in existing masonry created as a result of the *Work*, tooth-in salvaged brick masonry units to match existing coursing.
- .8 Do not install masonry units with face or faces exhibiting chips, cracks, blemishes, texture variation, and other imperfections detracting from appearance when viewed from distance of 4600 mm (15').
- .9 Do not install defective, cracked, and broken masonry units.
- .10 Mixing and blending: Mix units from a minimum of 3 pallets to ensure uniform blend of colour and texture and comply with manufacturer's recommended installation requirements. Distribute masonry units of varying textures to avoid spotty appearance over wall surfaces exposed to view. Do not use units which contrast too greatly with overall range.
- .11 Maintain bracing of walls and piers continuously during construction until structure provides support.
- .12 Locate bearings and piers as indicated. *Provide* solid masonry units at bearings. Grout under bearing plates installed on masonry with non-shrink grout.
- .13 Grouted reinforced masonry: incorporate reinforcing steel and construct masonry to indicated requirements.
- .14 Lay masonry level, true to line, square, plumb, and as indicated. Lay masonry courses in vertical alignment to ensure vertical joints align for full height of masonry and full height of building face.
- .15 Lay masonry in full bed of mortar, properly jointed with other work. Buttering corners of joints, and deep or excessive furrowing of mortar joints are not permitted.
- .16 Fully bond intersections, and external corners.
- .17 Do not adjust masonry units after placement. Where resetting of masonry is required, remove units, clean and reset in new mortar.
- .18 Cut masonry around obstructions, leaving maximum joint size as specified in this section (below).
- .19 Build chases, do not cut them.
- .20 Lay hollow concrete masonry units so that shells rest and align.
- .21 Exposed cuts shall be made clean and true with a suitable masonry saw.

3.5 Exposed Masonry

- .1 Do not lay chipped, cracked, blemished, and otherwise damaged units whether exposed or concealed.
- .2 Do not lay concrete masonry units that will appear smooth or slick where exposed to view, whether painted or not finished.
- .3 Remove chipped, cracked, and otherwise damaged units and replace with undamaged units.
- .4 Maintain and control water-to-cement ratio, rate of hydration, environmental conditions, tooling of the mortar joints, and cleaning procedures, to produce masonry of uniform appearance matching accepted mock-up.

Masonry Procedures

3.6 Jointing

- .1 Form tooled mortar joints whenever exposed to view, and behind cabinets, fitments, and wall accessories. Tool when mortar is thumb-print hard by tools having long bearing surface to avoid uneven depressions. Close cracks and crevices.
- .2 Tool with non-staining pointing tool to provide smooth, compressed, uniformly formed joints as follows:
 - .1 For exposed concrete unit masonry:
 - .1 Concave.
 - .2 For concealed masonry: strike flush joints concealed in walls and joints in walls to receive plaster, stucco, tile, insulation, resilient bases, or other applied material except paint or similar thin finish coating. Ensure that no mortar protrudes from joints on wall surfaces to receive materials and coatings.
 - .3 Joint thickness:
 - .1 Maintain mortar joint thickness of 10 mm (3/8"), unless otherwise specified, indicated or as required to align with existing jointing.
 - .2 At masonry cut around obstructions: maximum joint size of 13 mm (1/2").
- .3 Make joints of uniform thickness with vertical joints in alignment.
- .4 Trowel point joints in unpared masonry at below grade locations in contact with earth.
- .5 Form reglets where indicated for metal flashing in masonry.
- .6 Remove loose or defective mortar when masonry is removed and replace.
- .7 Rake out joints at junctions of masonry with concrete walls and columns, and at intersection of masonry walls and partitions where joint reinforcement is installed. These joints shall be sealed in accordance with Section 07 92 00.

3.7 Built-In Work

- .1 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
- .2 Coordinate and cooperate in the provisions for setting, anchorage and alignment of built-in work.
- .3 Metal door frames:
 - .1 Build masonry around metal door frames.
 - .2 Ensure that anchors are secured solidly, and that frames are true and plumb.
 - .3 Fill back void of frames with Type N or S mortar unless otherwise indicated.
 - .4 Protect frame with protective covering and leave no mortar on exposed frame faces.

3.8 Reinforced Masonry

- .1 Conform to requirements of CAN/CSA A371-14.
- .2 Grout beneath bearing plates: Fill voids beneath steel bases bearing on masonry with approved non-shrink grout having minimum compressive strength at 28 days cure time of values as indicated on Structural Drawings. In addition, use non-ferrous grout where grout is exposed to view, in-service moisture conditions, and weather.

Masonry Procedures

.3 Reinforced block lintels:

- .1 Install reinforced block lintels over doorways, other openings and recesses as indicated.
- .2 Support masonry units of reinforced block lintels built in place. *Provide* a level platform, true to the proper elevation and of sufficient strength to support the load without visible deflection. Maintain supports in place for a minimum of 7 days and for a period sufficient to permit the concrete to cure and gain sufficient strength to safely support all loads.
- .3 Lay masonry units with full mortar coverage on abutting edges with joints shoved tight. Where masonry construction is continued above the lintel, place the first course of masonry units on the lintel in full mortar bed.
- .4 Fill voids of masonry units that form the fill depth of lintel beams at one time per beam, with grout having minimum compressive strength at 28 days curing time of value as indicated on Structural Drawings.

3.9 Provision for Movement

- .1 Deflection space:
 - .1 Incorporate deflection space between tops of non-load-bearing walls/partitions and structure to prevent transference of structural loads to masonry.
 - .1 Interior masonry partition deflection space: 25 mm (1").
- .2 Coordinate work of this section with installation of lateral supports.

3.10 Lateral Supports

- .1 In addition to requirements of *Contract Documents*, *Provide* horizontal and vertical wall and partition lateral support anchors in accordance with CAN/CSA A370-14.

3.11 Movement (Control) Joints

- .1 For masonry without openings, space vertical movement joints at no more than 7620 mm (25') on centre, unless otherwise indicated on Structural Drawings.
- .2 For masonry with multiple openings, provide symmetrical placement of movement joints and reduced spacing of no more than 6096 mm (20 ft) on center, unless otherwise indicated on Structural Drawings.
- .3 Place movement joints at changes in wall direction, changes in building heights, at door and window locations where necessary and directed, at major changes in thickness of wall.
- .4 Extend movement joints to top of masonry, including parapets.
- .5 Review and coordinate movement joint locations with the *Consultant* prior to installation of masonry.

3.12 Temporary Bracing

- .1 *Provide* adequate temporary bracing to masonry walls until floor and roof decks are installed and can develop adequate diaphragm action to brace walls.

3.13 Field Quality Control

- .1 Conduct quality control and perform field control tests in accordance with CSA S304-14 and to requirements of Structural Drawings.

Masonry Procedures

3.14 Adjusting and Cleaning

- .1 Protect masonry and adjacent work from damage from cleaning work.
- .2 Clean masonry in accordance with masonry manufacturer's written requirements. Remove masonry and install new masonry, if masonry is damaged by cleaning work.
- .3 Use proprietary PH-neutral cleaning solution with water as approved by manufacturer of masonry units in accordance with manufacturer's written directions.
- .4 Test cleaning agent and procedures by cleaning small, inconspicuous sample location prior to commencement of overall cleaning work. Review cleaning test area with *Consultant* and obtain acceptance in writing prior to cleaning remainder of areas requiring cleaning.
- .5 Soak wall with clean water and flush off loose dirt and mortar.
- .6 Apply specified cleaning agent in accordance with the manufacturer's direction, working from top to bottom.
- .7 Rinse areas thoroughly with clean water to remove cleaning solutions, dirt, and mortar residue.
- .8 Remove mortar from exposed masonry face immediately after pointing and prior to full set to avoid mortar staining of masonry units. Remove efflorescence and mortar deposits from surfaces to receive coatings and surfaces which are exposed to view. Remove masonry and install new masonry, if mortar staining cannot be removed without damaging masonry work.
- .9 Remove mortar droppings from flashings and other materials immediately to prevent damage and discolouration.
- .10 Remove efflorescence and mortar deposits from surfaces to receive coatings or surfaces which are exposed to view, occurring within a time period of 1 year after date of *Substantial Performance of the Work*.

3.15 Protection

- .1 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.
- .2 Protect other materials and finishes from contamination by mortar droppings.
- .3 *Provide* temporary bracing of masonry work during and after erection until permanent lateral support is in place.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Mortar and grout for masonry work.
 - .2 Pigmented mortar at following masonry assemblies:
 - .1 Brick masonry units.
 - .2 Concrete masonry units.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 04 05 00.
- .2 Test and evaluation reports:
 - .1 Submit test results confirming compliance of aggregates with CAN/CSA A179-14.
- .3 Sample:
 - .1 Provide mortar colour samples to Consultant for review for approval.

1.3 Delivery, Storage, and Handling

- .1 Protect cementitious materials against moisture.
- .2 Prevent contamination by foreign materials, and freezing.

PART 2- PRODUCTS

2.1 Materials

- .1 Mortar and grout: Comply with CAN/CSA A179-14.
- .2 Portland cement: to CSA A3001-13, Type 10. For exposed mortar, maintain uniformity of cement manufacturer and batch for colour uniformity.
- .3 Hydrated lime: to ASTM C207-18, Type S.
- .4 Sand: to CAN/CSA A179-14.
- .5 Mortar pigment:
 - .1 Mortar colours shall contain pure, concentrated mineral pigments especially processed for mixing into mortar and complying with ASTM C979/C979M-16.
 - .2 Allow for blended mortar pigment colours to match each type of masonry veneer.
 - .1 Colours: to match existing.
 - .1 Colours shall be selected from full pricing range.
 - .2 Loading (% of cementing material):
 - .1 3% (half loading).
 - .3 Acceptable manufacturers:
 - .1 Davis Colors 'True Tone Sweet 16 Cement Colors'.

Mortar and Grout for Masonry

- .2 Lanxess Corporation 'Bayferrox Iron Oxide Pigments'.
- .3 Solomon Colors, Inc. 'Concentrated Mortar Colors'.

2.2 Material Source

- .1 Mortar and grout shall be factory prepared premix including sand and colour. Site mixing of bags and sand will not be accepted. Use mortar and grout as supplied by silo batched systems.
- .2 Maintain uniformity of mortar material manufacturers, mortar materials and source of aggregate throughout the *Work*.

2.3 Mortar Types

- .1 Mortar load bearing masonry: Type S.
- .2 Mortar for exterior masonry above grade; ready (silo) mixed:
 - .1 Loadbearing: Type S.
 - .2 Non-loadbearing: Type N.
 - .3 Mortar for exterior exposed masonry veneer: Type N, Portland Cement/Lime/Sand mix.
- .3 Mortar for interior masonry; ready (silo) mixed:
 - .1 Loadbearing: Type S.
 - .2 Non-loadbearing: Type N.

2.4 Mortar Colour

- .1 Mortar colour to match existing; for use as indicated, ready (silo) mixed mortar:
 - .1 Except where pigmented mortar is specified or indicated: Control mortar materials and workmanship to produce uniform grey colour (non-pigmented).

2.5 Grout Types

- .1 Grout for masonry: Grout to CAN/CSA A179-14.
 - .1 Compressive strength: in accordance with Structural Drawings.
 - .2 Slump: 200 mm (8") unless otherwise indicated.
- .2 Grout for hollow metal frames: Fine grout to CAN/CSA A179-14.
 - .1 Compressive strength: 15 MPa minimum.

PART 3 - EXECUTION

3.1 Masonry Procedures

- .1 Masonry procedures shall be in accordance with Section 04 05 00 as supplemented herein.
- .2 Comply with CAN/CSA A179-14, except where indicated otherwise.

3.2 Measurement and Mixing

- .1 Mix mortars and grout as specified in CAN/CSA A179-14 and pre-batch at factory. Use only dry aggregate. Test for bulking to determine accurate proportioning.
- .2 Adjust water in mortar mix to suit absorption rates of masonry units.

Mortar and Grout for Masonry

- .3 Concrete grout: mix as required to achieve specified compressive strength.

3.3 Grout

- .1 Place and grout reinforcing and bearing in accordance with Section 04 05 00, CAN/CSA A371-14, and as indicated.

3.4 Field Quality Control

- .1 Provide mortar for strength testing in accordance with CAN/CSA A179-14.
- .2 For pigmented mortars, in order to maintain uniformity of mortar pigment throughout the *Work*, make visual inspections of cement shade for each cement delivery and compare against future shipments. Cements exhibiting shade differences such that final colour of pigmented mortar will not be uniform throughout the *Work* or will not match the approved sample, shall be rejected and replaced at no additional cost to the *Owner*.

3.5 Protection

- .1 *Provide* protection where required at mixing areas to prevent damage attributed to materials of this section.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Horizontal reinforcing for masonry block wall and partition assemblies.

PART 2- PRODUCTS

2.1 Materials

- .1 General: in accordance with building code and CAN/CSA A370-14.
- .2 Corrosion protection; metal materials: in accordance with building code and CAN/CSA A370-14:
 - .1 Hot dipped after fabrication to ASTM A1064 / A1064M-18a, and ASTM A153/A153M-09 Class B2 (457 g/m²).
 - .1 Interior to air barrier location: Use mill galvanized.
 - .2 For metal located exterior to the air barrier membrane: Stainless steel Type 304/316.
- .3 Joint reinforcement:
 - .1 Acceptable manufacturers:
 - .1 Blok-Lok.
 - .2 Interior wall assemblies: 9 gauge mill galvanized wire ladder reinforcement.

PART 3- EXECUTION

3.1 Movement (Control) Joints

- .1 Installation requirements in accordance with Section 04 05 00 and as supplemented herein.
- .2 Stop reinforcing 25 mm (1") short of each side of movement joints unless otherwise indicated.

3.2 Horizontal Reinforcing

- .1 Joint reinforcement:
 - .1 Install horizontal joint reinforcement in cavity walls, solid walls, and partitions in accordance with CAN/CSA A371-14 and as indicated in the *Contract Documents*, the more stringent requirements shall govern.
 - .2 Place reinforcement continuously in horizontal joints at vertical spacing not exceeding 600 mm (24"), beginning with course 400 mm (16") above bearing, unless otherwise indicated.
 - .3 Do not carry reinforcement through intersections where lateral support anchors are installed, at intersections of walls and partitions with solid piers and at block movement joints.
 - .4 Reinforcement shall be lapped 300 mm (12"), minimum, with laps staggered 750 mm (30"), minimum, from course to course. Any cross wires in the lap length of the lapped reinforcement shall be removed.

3.3 Reinforced Masonry

- .1 Reinforce masonry lintels and bond beams as indicated. Make joints in lintels and bond beams to match adjacent walls.
- .2 Reinforce masonry walls as indicated on the structural drawings.
- .3 Place and grout reinforcing in accordance with CSA S304-14. Use concrete of 20 MPa strength.
- .4 *Provide* minimum 150 mm (6") bearing on supports for lintels.
- .5 Place 100% solid block at each jamb under lintels.

3.4 Bolts and Anchors

- .1 Embed bolts and anchors solidly in mortar or grout to develop maximum resistance to design forces.

3.5 Lateral Support and Anchorage

- .1 Install lateral support and anchorage in accordance with CAN/CSA A370-14 and as indicated on the structural drawings.

END OF SECTION

Brick Masonry Units

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Clay brick (Salvaged).

1.2 Submittals

- .1 Submit required submittals in accordance with Section 04 05 00.

PART 2 - PRODUCTS

2.1 Materials

- .1 Manufacture: Manufacture total required brick in one continuous batch, for maximum colour and texture uniformity.
- .2 Clay brick:
 - .1 Salvaged brick masonry units from existing.

PART 3- EXECUTION

3.1 Laying

- .1 Lay masonry in accordance with good practice, and CAN/CSA A371-14 and as accepted in mock-up sample wall and as specified in Section 04 05 00.
- .2 Review locations of coursing alignment and layout with *Consultant*, and seek approval, prior to commencement of the work of this section.

END OF SECTION

Concrete Masonry Units

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Concrete masonry units:
 - .1 Normal weight units.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 04 05 00.
- .2 In-situ carbon dioxide mineralization verification:
 - .1 Provide concrete masonry producer's verification of in-situ mineralization of carbon dioxide.

PART 2 - PRODUCTS

2.1 Materials

- .1 Concrete masonry units:
 - .1 Comply with CAN/CSA A165 SERIES-14.
 - .2 In-situ Carbon Dioxide Mineralization:
 - .1 In-situ carbon dioxide mineralization in concrete masonry units: Supply concrete masonry units that have undergone in-situ carbon dioxide mineralization, such that post-industrial carbon dioxide (CO₂) is injected into the concrete during mixing and chemically converted into a mineral.
 - .2 Acceptable technologies:
 - .1 CarbonCure Technologies Inc. 'CarbonCure'.
 - .2 Carboclave.
 - .3 Include shapes, such as end, bond, sash groove, ledge and lintel units, required to complete the *Work*, with uniform appearance.
 - .1 *Provide* open end blocks where vertical reinforcing occurs in walls.
 - .2 *Provide* knock-out blocks where horizontal reinforcing bars occur in walls.
 - .3 *Provide* bullnose units at interior partition, around door frames, jambs, headers, corners and where indicated.
 - .4 Solid concrete masonry units may be used where grouted block is indicated, whenever reinforcing is not indicated, in lieu of grouted solid installation method.
 - .5 Size: metric.
 - .4 Normal weight units:
 - .1 Hollow units: H/15/A/M, H/20/A/M, and H/25/A/M.
 - .2 Semi-solid units: SS/15/A/M, SS/20/A/M, and SS/25/A/M.
 - .3 Full solid units: SF/15/A/M, SF/20/A/M, and SF/25/A/M.

Concrete Masonry Units

- .4 Colour: grey.
- .5 Profiles: as indicated.

2.2 Source Quality Control

- .1 Perform tests on masonry units to determine compressive strength as required by jurisdictional authorities in accordance with CAN/CSA A165 SERIES-14.

PART 3 - EXECUTION

3.1 Preparation

- .1 Before commencing masonry work, verify that conditions at the *Place of the Work* will allow construction of masonry within required limitations for wall heights, wall thicknesses, openings, bond, anchorage, lateral support, and compressive strengths of masonry units and mortars.

3.2 Masonry Procedures

- .1 Lay masonry in accordance with good practice, and CAN/CSA A371-14, in accordance with Section 04 05 00.
- .2 Exposed corners at interior partitions shall utilise units with bullnose corners. At exterior exposed corners, extent of bullnose to be as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Architectural concrete masonry units.
 - .2 Precast concrete sill, match existing adjacent profile

1.2 Submittals

- .1 Submit required submittals in accordance Section 04 05 00.

1.3 Delivery, Storage, and Handling

- .1 Rejection of Defective Units:
 - .1 Inform *Consultant* upon receipt of any unit showing flaws or imperfections greater than tolerances at the storage yard or the *Place of the Work* for their review.
 - .2 The *Consultant* may reject the piece or approve its refabrication.
 - .3 Remove rejected units from the *Place of the Work* immediately.
- .2 Handling:
 - .1 Pack and load units for shipment and unloading at the *Place of the Work* in a manner to prevent damage.
 - .2 Use no material for blocking of packaging which would stain or discolour exposed surfaces of the units.
 - .3 Isolate units from contact with ground and other materials until laid, to prevent staining.
 - .4 Lift units with proper and sufficiently long slings or forks with protection provided so they are not damaged.
 - .5 Protect edges and corners to prevent damage.
- .3 Storage:
 - .1 Stack units on timbers or platforms at least 75 mm (3") above grade.
 - .2 Provide necessary means to prevent staining of units during storage.
 - .3 Place polyethylene or other plastic film between wood and other finished surfaces of units when stored for an extended period of time.
 - .4 Cover stored units if exposed to the weather for an extended period of time.
 - .5 Do not use salt to thaw ice formed on surface of units.

PART 2 - PRODUCTS

2.1 Architectural Concrete Masonry Units

- .1 Architectural concrete masonry units: to CAN/CSA A165 SERIES-14:
 - .1 Acceptable *Products, size, finish and colour*.
 - .1 To match existing adjacent.

- .2 Integral water repellent additive and mortar treatment: masonry unit manufacturer's standard product – Dry Block as required.
- .2 Manufacture total required architectural concrete masonry units in one continuous batch, for maximum colour and texture uniformity.

PART 3- EXECUTION

3.1 General

- .1 Lay masonry in accordance with good practice, and CAN/CSA A371-14 and as accepted in mock-up sample wall specified in Section 04 05 00.

3.2 Cutting of Units

- .1 Cut masonry units with wet-saw.
- .2 Pre-soak units using clean water prior to cutting.
- .3 Clean cut units using a stiff fibre brush and clean water. Allow units to surface dry prior to placement.

3.3 Tolerances

- .1 Variation in alignment from unit to adjacent unit: 1.5 mm (1/16") maximum.
- .2 Variation of mortar joint thickness: 3 mm every 1000 mm (1/8" every 36").

3.4 Adjusting and Cleaning

- .1 Clean masonry as work progresses. Allow mortar droppings on masonry to partially dry then remove by means of brushing with a stiff fibre brush.
- .2 Post-Construction: Clean mock-up panel as directed below and leave for one week. If no harmful effects appear and after mortar has set and cured, clean masonry as follows:
 - .1 Protect windows, sills, doors, trim and other work from damage.
 - .2 Remove large particles with stiff fibre brushes without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.
 - .3 Scrub with solution approved by masonry unit manufacturer, then clean off immediately with clean water using hose.
 - .4 Repeat cleaning process as often as necessary to remove mortar and other stains.
- .3 Use alternative cleaning solutions and methods for difficult to clean masonry only after consultation with masonry unit manufacturer.

3.5 Protection

- .1 Protect masonry units from damage resulting from subsequent construction operations.
- .2 Use protection materials and methods which will not stain or damage masonry units.
- .3 Remove protection materials upon *Substantial Performance of the Work*, or when risk of damage is no longer present.

END OF SECTION

Metal Fabrications

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Work of this section includes metal fabrications and related metals including, but not limited to, the following:
 - .1 Loose steel lintels: Interior lintels shall be primed; finish painting coats shall be provided in accordance with Section 09 91 00. Exterior lintels shall be hot dip galvanized.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting.

1.3 Submittals

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

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors: work of this section shall be executed only by a *Subcontractor* who has adequate plant, equipment, and skilled tradespersons to perform work expeditiously, and is known to have been responsible for satisfactory installations similar to that required in the *Work*.
 - .2 Aspects of the work of this section are required to be prepared by a professional engineer.
- .2 Requirements of regulatory agencies: the work of this section that functions to resist forces imposed by dead and live loads shall conform to requirements of jurisdictional authorities.
- .3 Mock-ups:
 - .1 *Provide* mock-up of stair, showing stringer, tread and riser, including railing with pickets for the following stairs:

Metal Fabrications

1.5 Delivery, Storage, and Handling

- .1 For aluminum fabrications comply with AAMA CW-10 – Care and Handling of Architectural Aluminum from Shop to Site.
- .2 Label, tag or otherwise mark metal fabrications supplied for installation by other sections to indicate its function, location in building and shop drawing designation.
- .3 Protect work from damage during delivery, storage and handling.
- .4 Deliver work to location at the *Place of the Work* designated by *Contractor* and to meet requirements of construction schedule.

1.6 Warranty

- .1 Warrant work of this section for a period of 2 years.

PART 2- PRODUCTS

2.1 Performance/Design Requirements

- .1 Design, fabricate, and install work of this section in accordance with the building code and requirements of all other governing authorities.
 - .1 Where hard floor finishes are indicated or scheduled as the floor finish on treads and landings, treads and landings shall be designed to limit live load deflection to span/720 and total deflection to span/360.
- .2 Welding:
 - .1 Weld structural components in steel to conform to requirements of CSA W59-13, and by a fabricator fully certified by the Canadian Welding Bureau to conditions of CSA W47.1-09(R2019) and CSA W55.3-08 (R2018) as applicable.
 - .2 Weld components in aluminum to conform to requirements of CSA W59.2-M1991 (R2013), and by a fabricator certified by the Canadian Welding Bureau to conditions of CSA W47.2-11(R2015).
 - .3 Weld stainless steel components to conform to requirements of CSA W59-13 and ANSI/AWS D1.6/D1.6M-2007 as applicable, and by a fabricator fully certified by the Canadian Welding Bureau to conditions of CSA W47.1-09(R2019).
- .3 Design assemblies and connections to withstand own dead load, live loads, super-imposed dead loads, and fabrication forces, without permanent distortions or deformation, to maximum allowable deflection of L/360, within the following construction tolerances:
 - .1 Maximum variation from plumb in vertical lines:
 - .1 3.2 mm (1/8") in 3 m (10'-0").
 - .2 Maximum variation from level:
 - .1 3.2 mm (1/8") in 9 m (30'-0").
 - .3 Maximum variation from straight:
 - .1 3.2 mm (1/8") in 3 m (10'-0") under a 3 m (10'-0") straight edge.
 - .4 Maximum variation from angle indicated:
 - .1 10 seconds.
 - .5 Tolerances shall be non-cumulative.

Metal Fabrications

2.2 Materials

.1 General:

- .1 Unless detailed or specified otherwise, standard *Products* will be acceptable if construction details and installation meet intent of the *Contract Documents*.
- .2 Include materials, *Products*, accessories, and supplementary parts necessary to complete assembly and installation of work of this section.
- .3 Incorporate only metals that are free from defects that are visible, or that impair strength or durability. Install only new metals of best quality, and free from rust or waves and buckles, and that are clean, straight, and with sharply defined profiles.
- .4 The engineer responsible for the production of the shop drawings is responsible for structural design, member sizes, arrangement, connections and anchoring of work of this section. Coordinate and maintain materials, dimensions, layout and appearance to meet intent of the *Contract Documents*.

.2 Metals:

.1 Steel:

- .1 Structural shapes, plate, bars: hot-rolled, CSA G40.21-13, Grade 300W.
- .2 Hollow structural sections: hot-formed, seamless, CSA G40.21-13, Grade 350W, Class H.
- .3 Mild sheet and strip, hot rolled, ASTM A1011/A1011M-14.
- .4 Steel pipe to ASTM A53/A53M-12, Type E or S, Grade A or B, standard weight, Schedule 40 seamless black or AISI MT 1010/1015, or acceptable alternative.

.2 Standard access grilles, galvanized finish.

2.3 Accessories

.1 Fasteners:

- .1 Fasteners: Exposed fasteners to match the material surface on which they occur.
- .2 Fasteners for stainless steel to be stainless steel 300 Series or stainless steel 400 Series.
- .3 Fasteners in contact with aluminum to be stainless steel 300 Series, stainless steel 400 Series, cadmium plated or aluminum.
- .4 Bolts and anchor bolts: to ASTM A307-14e1.
- .5 High strength bolts: to ASTM A325-14.
- .6 Use embedded epoxy set anchors for anchorage to concrete at exterior locations exposed to weather, unless otherwise indicated; installation and embedment depth shall be as per manufacturer's requirements, embedment depth shall not be greater than 80% of concrete thickness.
- .7 Other types of fasteners as appropriate to meet design requirements.

.2 Welding materials:

- .1 Steel: to CSA W59-13.

.3 Grout:

- .1 Epoxy grout; non-shrink, non-expanding:

Metal Fabrications

- .1 Hilti 'HY-200'.
- .2 Sika 'Sika AnchorFix 3001'.
- .3 W.R. Meadows 'REZI-WELD 3/2 EPOXY GROUT/PATCH'.
- .2 Cementitious grout: non-shrink, non-expanding to ASTM C1107/C1107M-20:
 - .1 Sika 'Sika Grout 212' or 'Sika M-Bed Standard'.
 - .2 W.R. Meadows 'Sealtight CG-86 Construction Grout'.
- .4 Dielectric separator: Best grade, quick drying non-staining alkali resistant bituminous paint to CAN/CGSB 1.108-M89, or membrane type to acceptance of *Consultant*.

2.4 Finishes

- .1 Quick-drying one-coat paint: CISC/CPMA 1-73a. Colour as selected by *Consultant*.
- .2 Shop primer; steel: CISC/CPMA 2-75 or SSPC-Paint 20, Paint Specification No. 20: Zinc-Rich Primers (Type I "Inorganic" and Type II "Organic").
- .3 Zinc rich paint; steel: Two-component zinc-rich coating, zinc powder to ASTM D520-00(2011) Type III ,SSPC-Paint 20, Type 1 Inorganic or single-component zinc-rich coating to SSPC-Paint, Type 2 Organic, CAN/CGSB 1.181-M99, VOC content <100 g/l to ASTM-D1475.
 - .1 Acceptable *Products*:
 - .1 Aervoe Industries, Inc. 'Low VOC Cold Galvanize Coating 93% Zinc'.
 - .2 ZRC Worldwide 'ZRC Zero-VOC Galvanizing Compound'.
- .4 Hot dip galvanizing: conforming to ASTM A123/A123M-13, minimum zinc coating of 600 g/m². Use air cooling method (no water or chromate dipping treatment permitted).

2.5 Fabrication

- .1 General:
 - .1 Fabricate metal fabrications with machinery and tools specifically designed for the intended manufacturing processes and by skilled tradesmen.
 - .2 Fit and assemble metal fabrications in shop. When this is not possible, make a trial shop assembly.
 - .3 Incorporate anchors at 610 mm (24") on centre or as otherwise required for secure attachment for metal fabrications located in cast-in-place concrete and concrete masonry units.
 - .4 Incorporate means for fastenings of other work secured to work of this section.
- .2 Construction:
 - .1 Fabricate with materials, component sizes, metal gauges, reinforcing, anchors, and fasteners of adequate strength to withstand intended use, and within allowable design factors imposed by jurisdictional authorities. Fabricate items from steel unless otherwise noted.
 - .2 Ensure that metal fabrications will remain free of warping, buckling, opening of joints and seams, distortion, and permanent deformation.
- .3 Assembly:

Metal Fabrications

- .1 Accurately cut, machine and fit joints, corners, copes and mitres so that junctions between components fit together tightly and in true planes.
 - .2 Provide smooth welds with splatter removed where exposed to view.
 - .3 Allow for differential movements within assemblies and at junctions of assemblies with surrounding *Work*.
 - .4 Field welding of hot dipped galvanized members permitted only when other fastening methods are not possible. Locations of field welds to be clearly identified on reviewed shop drawings.
 - .5 Incorporate holes and connections for work installed under other sections.
 - .6 Cleanly and smoothly finish exposed edges of materials including holes.
 - .7 Cap open ends of sections exposed to view, such as pipes, channels, angles, and other similar work.
- .4 Shop prime painting:
- .1 Clean loose mill scale, rust, dirt, weld flux and spatter from the work after fabrication.
 - .2 Prepare and prime paint in accordance with manufacturer's installation requirements. Prepare steel by methods specified in CISC/CPMA 2-75 or SSPC-SP3-82 (R2004).
- .5 Shop prime painting; premium quality:
- .1 Clean loose mill scale, rust, dirt, weld flux and spatter from work after fabrication.
 - .2 Clean and prepare surfaces to meet specified requirements of SSPC SP-6 and paint manufacturer's installation requirements.
 - .3 Apply primer in accordance with paint manufacturer's installation requirements.
- .6 Galvanizing:
- .1 Galvanize metal fabrications following fabrication.
 - .2 Paint damage galvanized surfaces with zinc rich paint, immediately following damage to galvanized protection. Prepare substrate to remove oil and grease to SSPC-SP1-82(R2004), rust scale to SSPC-SP3-82 (R2004), mill scale to SSPC-SP6.
 - .3 Fill vent and drain holes that are exposed in the finished *Work*, unless indicated to remain as weep holes in exterior fabrications, by plugging with zinc solder and filing off smooth.

PART 3 - EXECUTION

3.1 Examination

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

3.2 Installation

- .1 Install metal fabrications plumb, true, square, straight, level, and accurately and tightly fitted together and to surrounding work.
- .2 Include in work of this section anchor bolts, high tensile bolts, washers and nuts, expansion bolts, toggles, straps, sleeves, brackets, clips, and other items necessary for secure installation as required by loading and jurisdictional authorities.

Metal Fabrications

- .3 Countersink holes at wood screw locations where wood is attached to work of this section.
- .4 Attach metal fabrications to interior concrete and masonry with corrosion resistant expansion bolts to support load with a safety factor of 3.
- .5 Attach metal fabrications to exterior concrete and masonry with non-shrink epoxy cement to support load with a safety factor of 3.
- .6 Insulate between dissimilar metals or between metal, and masonry or concrete with bituminous paint to prevent electrolytic action.
- .7 Where indicated, grout metal posts, pickets, balusters, and the like, in metal sleeves cast into concrete, with non-shrink quick setting epoxy anchor cement, unless detailed otherwise. Fabricate sleeves of 75 mm (3") minimum in depth.
- .8 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .9 Install ladders to suit locations indicated complete with safety cages where required. Galvanized finish. Reinforce walls as required to receive ladders.
- .10 Through bolt or cast-in ladder anchorage assemblies unless otherwise approved by authorities having jurisdiction.
- .11 Apply adhesive for steel bases in accordance with manufacturer's requirements and recommendations.

3.3 Field Quality Control

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

3.4 Adjusting and Cleaning

- .1 After erection, touch up primed surfaces that are burned, scratched or otherwise damaged with prime paint to match shop paint.
- .2 Clean and repair areas of bare metal and welds on galvanized surfaces with zinc rich paint. Welded area of members to be masked to minimize overpainting of adjacent undamaged surfaces. Prepare substrate to remove oil and grease to SSPC-SP1-82(R2004), rust scale to SSPC-SP3-82 (R2004), mill scale to SSPC-SP6.
- .3 Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new.

3.5 Protection

- .1 Protect finished surfaces from damage from time of installation until final finishes are applied or to final cleanup.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Architectural metal fabrications shall consist of metal fabrications which consist of the following:
 - .1 Non-ferrous metal fabrications
 - .2 Expanded wire mesh gas meter enclosure.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting.

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .2 Shop drawings:
 - .1 Submit a list of fabrications to be *Provided* as part of the work of this section.
 - .2 Include plans, sections and large scale details, exposed-to-view edge conditions.
 - .3 Indicate materials, including material characteristics, profiles of each metal fabrication member, methods of assembly and joinery, fittings, fastenings, finishes, anchorages, welds, solders, brazing, and their structural characteristics relative to their purpose, accessory items, and other fabrication information required.
 - .4 Indicate proposed *Place of the Work* connections and methods.
 - .5 Submit coordination drawings indicating locations of concealed grounds, cutouts, plates, and other required fabrications.
 - .6 Show relation to adjoining construction, details of outside and inside corners and door openings.
- .3 Samples:
 - .1 Submit 3 sets of 200 mm x 200 mm (8" x 8") samples of architectural metals, with specified finish and metal fasteners.
 - .2 Provide fastener samples for each type required.

1.4 Closeout Submittals

- .1 Operation and maintenance data:
 - .1 Manual shall include detailed maintenance and cleaning procedure for materials and finishes requiring specific care, noting particularly those procedures or materials which will cause damage to finished surfaces.

1.5 Quality Assurance

- .1 Qualifications:

Architectural Metal Fabrications

- .1 Installers / applicators / erectors: Execute work of this section only by a *Subcontractor*, shop foreperson, and *Place of the Work* installation foreperson who have adequate plant, equipment, and skilled tradespersons to perform work expeditiously, and is known to have been responsible for installations similar to that specified during a period of at least the immediate past 10 years. Fabricators shall have experience working with all metal types specified in this section.
 - .1 Provide separation of stainless steel or non-ferrous metals fabrication areas from mild steel fabrication areas.
 - .2 Grinders, wire brushes, and tools used on stainless steel or non-ferrous metals shall be free of materials which will leave or produce dissimilar material or metal oxides deposits. Tools previously used on mild steel shall not be used on stainless steel or non-ferrous metal work.
 - .3 Do not bring iron or mild steel surfaces into contact with stainless steel or non-ferrous metals, including lifting tools, steel tables, storage racks, and other storage and handling equipment.
 - .4 Cutting or grinding debris from iron or mild steel materials shall not be permitted to settle on stainless steel or non-ferrous materials and fabrications.
 - .5 Perform water-wetting and drying tests during finishing indicating free iron on finished stainless work in accordance with ASTM A380-06.

1.6 Delivery, Storage, and Handling

- .1 Label, tag or otherwise mark work supplied for installation by other sections to indicate its function, location in building and shop drawing designation.
- .2 Metals subject to corrosion during handling and storage shall be protected from exterior and adverse conditions to preserve finish.
- .3 Deliver work to location at the *Place of the Work* designated by *Contractor* and to meet requirements of construction schedule.
- .4 For metalwork items which are susceptible to damage from construction activities provide strippable temporary protective film on factory finished or prefinished surfaces before shipping.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Design assemblies and connections to withstand own dead load, super-imposed dead loads, live load, and fabrication forces, without permanent distortions or deformation, to maximum allowable deflection of L/360, within the following construction tolerances:
 - .1 Edges and surfaces shall be uniform for all like metalwork.
 - .2 Limit inconsistencies in edge and surfaces to those which can be identified when viewed from distance of not greater than 300 mm (12").
 - .3 Surfaces of panels shall be flat and free of distortion when viewed from any distance or angle from surface.
 - .4 Finish shall be uniform when viewed from any distance from surface or from like surfaces which are viewed from within the same viewing area.
 - .5 Limit variations from plumb and level:
 - .1 3.2 mm in 6096 mm (1/8" in 20'-0") vertically and horizontally.

Architectural Metal Fabrications

- .2 6.4 mm in 12192 mm (1/4" in 40'-0") either direction.
- .6 Limit offsets in theoretical end-to-end and edge-to-edge alignment:
 - .1 1.6 mm (1/16") where surfaces are flush or less than 12.7 mm (1/2") out of flush and separated by not more than 50 mm (2").
 - .2 3.2 mm (1/8") for surfaces separated by more than 50 mm (2").
- .7 Step in face: 1.6 mm (1/16") maximum.
- .8 Jog in alignment: 1.6 mm (1/16") maximum.
- .9 Location: 6.4 mm (1/4") maximum deviation of any member at any location.
- .10 Tolerances are not cumulative.
- .2 Welding:
 - .1 Weld components in steel to conform to requirements of CSA W59-13, and by a fabricator fully certified by the Canadian Welding Bureau to conditions of CSA W47.1-09(R2014) and CSA W55.3-08 (R2013) as applicable.
 - .2 Weld components in aluminum to conform to requirements of CSA W59.2-M1991 (R2013), and by a fabricator certified by the Canadian Welding Bureau to conditions of CSA W47.2-11(R2015).
- .3 Detail and fabricate stairs to NAAMM Metal Stairs Manual fifth edition 1992; Architectural Class.

2.2 Materials

- .1 General:
 - .1 Unless detailed or specified otherwise, standard *Products* will be acceptable if construction details and installation meet the requirements and intent of the *Contract Documents*.
 - .2 Include materials, accessories, and supplementary parts necessary to complete assembly, support, anchorage, and installation of architectural metal fabrications.
 - .3 Incorporate only metals that are free from defects that impair strength, durability, or are visible. Install only new metals of best quality, and free from rust or waves and buckles, and that are clean, straight, and with sharply defined profiles.
- .2 Metals:
 - .1 Steel:
 - .1 Structural shapes, plate, bars: hot-rolled, CSA G40.21-13, Grade 300W, unless otherwise indicated.
 - .2 Mild steel sheet and strip, hot rolled, ASTM A1011/A1011M-14, Commercial.
 - .3 Steel sheet and strip, hot rolled, ASTM A830/A830M-18, Commercial C2, pickled and oiled.
 - .4 Hollow structural sections: hot-formed, seamless, CSA G40.21-13, Grade 350W, Class H, unless otherwise indicated.
 - .5 Cold rolled sheet, stretcher levelled, fully pickled, ASTM A1008/A1008M-13, Grade CS Type A exposed, matte finish, oiled, unless otherwise indicated.
 - .6 Steel pipe to ASTM A53/A53M-12, Type E or S, Grade A or B, standard weight, Schedule 40 seamless black or AISI MT 1010/1015, unless otherwise indicated.
 - .3 Premanufactured wire mesh enclosure

Architectural Metal Fabrications

- .1 System 840 by Wirecrafter or approved alternative.
 - .1 Partition mesh: 10 gauge welded steel wire fabric conforming to CSA G30.5-M, longitudinal wire size MW 9.1, transverse wire size MW 9.1, opening size 2"x2", provide in flat sheets.
 - .2 Steel components: to CAN/CSA-G40.21, Grade 350W.
 - .3 Posts: hollow steel tubing, square 50 x 50 mm square, minimum wall thickness 2 mm, welded construction, designed to fasten to floors, walls, and ceiling.
 - .4 Angle frame: 32 x 32 x 3 mm.
 - .5 Bolts, fasteners and fastening hardware: manufacturer's standard to suit design and application.
 - .6 System to be c/w galvanized steel angle framing and fastening. Fasten framing to existing masonry building face as required. Flush trim edge finish
 - .7 Hinges: 3 5-knuckle tight-pin butt hinges fastened to door panel and frame
 - .8 Locking: Mortise cylinder lock operated by thumb turn latch outside, key inside.
 - .1 Keyed to match the school's custodial locks.
 - .9 Finish: shop painted, powder paint, colour as selected by Consultant.
 - .1 Similar to Tiger Drylac series 58/68 (epoxy TGIC free), to AAMA 2604-17a, colour finish as selected by Consultant from manufacturer's standard selection.
- .2 Fabrication: Mesh is securely welded to frame with flat steel stiffeners welded to frame for extra strength where needed.

2.3 Accessories

- .1 Fasteners:
 - .1 Fasteners shall be tamperproof where exposed.
- .2 Welding materials:
 - .1 Steel: to CSA W59-13.
- .3 Dielectric separator (Isolation material): Non-staining alkali resistant, 10 mil PVC membrane type, electrolytic isolation factor of 1.0.
- .4 Grout:
 - .1 Epoxy grout; non-shrink, non-expanding:
 - .1 Hilti 'HY-200'.
 - .2 Sika 'Sika AnchorFix 3001'.
 - .3 W.R. Meadows 'REZI-WELD 3/2 EPOXY GROUT/PATCH'.
 - .2 Cementitious grout: non-shrink, non-expanding to ASTM C1107/C1107M-17:
 - .1 Sika 'Sika Grout 212' or 'Sika M-Bed Standard'.
 - .2 W.R. Meadows 'Sealtight CG-86 Construction Grout'.

2.4 Finishes

- .1 Prime paint:

Architectural Metal Fabrications

- .1 Architectural grade (exposed) fabrications: Provide primers that comply with primers and finish systems specified in Section 09 91 00.

2.5 Fabrication

- .1 General:
 - .1 Fabricate with machinery and tools specifically designed for intended manufacturing processes.
 - .2 Fit and assemble architectural metal fabrications in shop. When this is not possible, make a trial shop assembly.
- .2 Construction:
 - .1 Fabricate with materials, component sizes, metal thicknesses (gauges), reinforcing, anchors, and fasteners of adequate strength to withstand intended use, and within allowable design factors imposed by Authorities with Jurisdiction. Fabricate items from steel unless otherwise noted.
 - .2 Ensure that work will remain free of warping, buckling, opening of joints and seams, distortion, and permanent deformation to expansion and contraction forces and loads.
 - .3 Construct items that are part of floor construction, to support the same live loads for which surrounding construction is designed.
- .3 Assembly:
 - .1 Accurately cut, machine and fit joints, corners, copes and mitres so that junctions between components fit together tightly and in true planes.
 - .2 Corners shall be mitred unless otherwise noted.
 - .3 Allow for differential movements within assemblies and at junctions of assemblies with surrounding work.
- .4 Finish work:
 - .1 Incorporate holes and connections for work installed under other sections.
 - .2 Cleanly and smoothly finish exposed edges of materials including holes.
 - .3 Cap open ends of sections exposed to view, such as pipes, channels, angles, and other similar work.
- .5 Galvanizing:
 - .1 Galvanize metalwork following fabrication except where impossible. Paint galvanized surfaces that are cut, welded or threaded with zinc rich paint to ensure a minimum coating of 0.102 mm, immediately following damage to galvanized protection.
 - .2 Fill vent and drain holes that are exposed in the finished *Work*, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- .6 Architectural grade (exposed) fabrications:
 - .1 Fabrications exposed to view shall be of the highest architectural quality, free of scratches, pitting, roughness, marring, discolouration, seams, staining and other imperfections with the quality of workmanship conforming to the workmanship classifications of Class 1 as defined in NAAMM AMP 555, paragraph 8.3 of Section 8, Quality Control or Assurance and as follows:

Architectural Metal Fabrications

- .1 Exposed surfaces are finished smooth with pits, mill marks, nicks and scratches filled or ground off. Defects shall not show when painted or polished. Remove sharp corners and edges.
 - .2 Conceal welds where possible. Where exposed, grind welds to small radius with uniform sized cove. Welds shall appear continuous in appearance. When painted or polished welds shall be undetectable.
 - .3 Use only flat head countersunk bolts in exposed locations unless indicated otherwise.
 - .4 Distortions shall not be visible to the eye.
 - .5 Exposed joints shall be fitted to hairline finish.
- .2 Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
 - .3 Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
 - .4 Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the work.
 - .5 Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.
 - .6 Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm (0.040") unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
 - .7 Mill joints to a tight, hairline fit. Cope or mitre corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.
 - .8 Weld behind finished surfaces without distorting or discolouring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces. Where welding cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.
 - .9 Surface preparation; non-ferrous metals: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform finish, free of cross scratches. Run grain of directional finishes with long dimension of each piece.
- .7 Shop prime painting:
 - .1 Clean loose mill scale, rust, dirt, weld flux and spatter from the work after fabrication.
 - .8 Powder painting:
 - .1 Apply powder paint in accordance with the manufacturer's requirements and recommendations and as follows.
 - .2 Clean surfaces to be coated as follows:
 - .1 Remove dust, dirt, and other surface debris by vacuuming, wiping dry with clean cloths or compressed air.
 - .2 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

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- .3 Allow surfaces to drain completely and allow to thoroughly dry.
- .3 If the above procedures do not clean the substrate surfaces, clean the surfaces with high pressure water washing.
- .4 Apply pretreatment as soon as possible after cleaning and before surface deterioration occurs.
- .5 Pre-treat iron phosphate for steel, zinc phosphate for galvanized or steel structures, and yellow or green chromating, or approved chrome-free for aluminum substrates.
- .6 Spray application:
 - .1 Apply coating to requirements of coating manufacturer's written application requirements.
 - .2 Method of Application: as recommended by paint system manufacturer.
 - .3 Spray application.
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of properly fluidizing powder coating to be applied.
 - .2 Apply coating materials to clean surfaces to minimum 2.5 - 3.5 mil dry film thickness or as specified by manufacturer.
 - .3 Ensure coating adheres to internal corners and recessed areas.
 - .4 Allow surfaces to cure for minimum time period as required by manufacturer.
 - .5 Cure in accordance with manufacturer's cure curves.

PART 3 - EXECUTION

3.1 Examination

- .1 Take measurements at the *Place of the Work* to ensure that work is fabricated to fit surrounding construction, around obstructions and projections in place, or as indicated, and to suit service locations.
- .2 Inspect surfaces on which work of this section is dependent for any irregularities detrimental to installation and performance of the work of this section. Confirm conditions are satisfactory before proceeding.

3.2 Installation

- .1 Install work plumb, true, square, straight, level, and accurately and tightly fitted together and to surrounding Work and as required for proper performance.
- .2 Supply and install anchor bolts, high tensile bolts, washers and nuts, expansion bolts, toggles, straps, sleeves, brackets, clips, and other items necessary for secure installation as required by loading and jurisdictional authorities.
- .3 Countersink holes provided for wood screws where wood is attached to work of this section.
- .4 Attachment considerations: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between units and building structure or between components themselves.
- .5 Obtain Consultant's approval for connections, joints, and fastening locations.

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- .6 System shall accommodate movement of components without buckling, failure of joint seals, undue stress on fasteners, or other detrimental effects when subjected to seasonal temperature changes and live loads.
- .7 Fasten railing anchors at the *Place of the Work*. Coordinate with related *Subcontractors*.
- .8 Insulate between dissimilar metals, between metal and masonry, and between metal and concrete with bituminous paint to prevent electrolytic action.
- .9 Grout metal posts, pickets, balusters, and the like, in metal sleeves cast into concrete, with non-shrink quick setting epoxy anchor cement, unless detailed otherwise. Fabricate sleeves of 75 mm (3") minimum depth.
- .10 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .11 Erect members and component parts plumb, level and true to building lines, in correct relation to work of other sections and established lines, curves and levels indicated.
- .12 Securely anchor metal framing to concrete by means of anchor rods with epoxy adhesive, shim and pack to true straight lines and levels.
- .13 Field welding:
 - .1 Comply with applicable specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections given above in this section.
 - .2 Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

3.3 Adjusting and Cleaning

- .1 After erection, touch up primed surfaces that are burned, scratched or otherwise damaged with prime paint to match shop paint.
- .2 Repair areas of bare metal and welds on galvanized surfaces with zinc rich paint.
- .3 Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new.
- .4 Clean and polish metal surfaces after installation is complete. Use only materials that won't scratch or mar finished surfaces and as approved by material manufacturers.

3.4 Protection

- .1 Protect finished surfaces from damage from time of installation until final finishes are applied or to final cleanup.

END OF SECTION

PART 1- GENERAL

1.1 Summary

- .1 Work of this section includes architectural woodwork including, but not limited to, the following:
 - .1 Cabinetry and hardware.
 - .2 Wood framed interior screens.
 - .3 Sink Millwork.
 - .4 Plastic laminate window sills.
 - .5 Countertops.
 - .6 Factory and site finishing of architectural woodwork.

1.2 Administrative Requirements

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

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data for each type of *Product* and process proposed for use in the work of this section and incorporated into items of architectural woodwork.
- .2 Shop drawings:
 - .1 Submit shop drawings for the work of this section complying with the North American Architectural Woodwork Standards 3.1 requirements.
 - .2 Indicate quality standards and grades.
 - .3 Include full scale drawings of all exposed-to-view edge conditions.
 - .4 Include plans, sections and large scale details, and indicate components and methods of assembly, fastenings, and other fabrication information required for the work of this section. Indicate assembly joint lines.
 - .5 Include materials and their characteristics and finishes as applicable including the following:

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- .1 Panel core and material types, thicknesses, compliance with specified standards, special treatments.
- .2 Adhesive types to be used and locations.
- .3 Finishing requirements including North American Architectural Woodwork Standards 3.1 finish system number, sheen, and required application steps.
- .6 Submit coordination drawings indicating locations of concealed grounds, cut-outs, plates, and other required fabrications.
- .7 Show relation to adjoining construction, details of outside and inside corners and door openings.
- .8 Provide flame spread ratings of walls and ceiling finishes to meet building code requirements, tested and listed by accredited listing agency.
- .3 Selection samples:
 - .1 Submit 3 sets of samples for initial selection purposes of actual veneers showing full range of grain variation, colour and matching, natural characteristics reflecting wood cut and species, manufacturing characteristics, and for each wood species specified. Submit samples as many times as required until approved by *Consultant*. First submission to include one set of samples per *Consultant* request plus one set lighter in tone and one set darker in tone.
 - .1 150 mm (6") widths, for each colour and finish and installed condition, finished on one side and one edge, complete with plastic laminated end as applicable.
 - .2 No less than one-half hide for leather upholstery and related attachment and seaming materials.
- .4 Verification samples:
 - .1 Submit samples for purpose of verification of compliance with specified requirements.
 - .2 Submit 3 sets of 200 mm x 200 mm (8" x 8") samples, or 200 mm (8") long as applicable, of each specified *Product*, material and finish, including but not limited to the following:
 - .1 Shop finished materials, showing each type of finish and colour.
 - .2 Samples of each specified *Product*, in each specified colour and finish.
 - .3 Plastic laminates, in each specified colour and finish.

1.4 Closeout Submittals

- .1 Operation and maintenance data:
 - .1 Submit maintenance and cleaning instructions for finishes requiring specific care, noting particularly those procedures or materials which will cause damage to finished surfaces to be included in maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 Fabricator solid surfacing: Fabrication to be performed by a solid surface manufacturer's certified fabricator Submit certification letter prepared by the solid surfacing manufacturer.
- .2 Quality standard:

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- .1 Work shall be in accordance with the North American Architectural Woodwork Standards 3.1, Custom Grade, or the highest grade available for performance and appearance characteristics of materials in Sections 3 – 5 used that apply to *Product* fabrication and installation requirements governed by Sections 6 – 12.
- .3 Requirements of regulatory agencies: the work of this section that functions to resist forces imposed by dead and live loads shall conform to requirements of jurisdictional authorities.

1.6 Delivery, Storage, and Handling

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

1.7 Field Conditions

- .1 Environmental conditions:
 - .1 During storage and installation: Obtain and comply with North American Architectural Woodwork Standards 3.1 for optimum temperature and relative humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained. Woodwork shall be acclimatized for a minimum of 72 hours prior to commencing woodwork installation.
 - .2 During finishing: Comply with Architectural Woodwork Standard's temperature and humidity requirements before, during, and after application of finishes.
 - .3 During service life of woodwork: Obtain and comply with woodwork manufacturer's advice for optimum temperature and humidity conditions. Note that building humidity control is not in operation 24 hours per day or 365 days per year and system is intermittent during winter and summer months. As a result, fabrication of wood components should anticipate major changes in humidity levels.

1.8 Extended Warranty

- .1 Warrant work of this section for a period of 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Casework integrity shall meet the minimum acceptance levels in accordance with SEFA 8-1999 as outlined in the North American Architectural Woodwork Standards 3.1 and additional or greater loading capacities as specified throughout the North American Architectural Woodwork Standards 3.1.
- .2 Maximum allowable adjustable shelf lengths shall comply with shelves assembly rules per the North American Architectural Woodwork Standards 3.1 based on shelf thickness indicated or scheduled.

Architectural Woodwork

2.2 General

- .1 Single-source manufacturing and Installation responsibility: Engage a qualified Manufacturer to assume undivided responsibility for woodwork specified in this section, including fabrication, finishing, and installation.

2.3 Wood Materials

- .1 Lumber:
 - .1 Hardwood for concealed blocking and framing: Economy grade, any species that, when painted, will not show any defects.
 - .2 Hardwood for exposed blocking: species and grade to match panel veneer.
 - .3 Moisture content: *Provide* kiln-dried (KD) lumber with moisture content range between 6% to 12% for interior architectural woodwork. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed 5% to 10%.
 - .4 Solid hardwood for transparent finish.
 - .1 Species:
 - .1 White oak.
 - .2 Cut:
 - .1 Quarter sawn.
- .2 Wood veneers:
 - .1 Allowable wood veneer face grade characteristics shall comply with North American Architectural Woodwork Standards 3.1 referenced grade and referenced standards.
 - .2 Hardwood veneer; for transparent finish:
 - .1 Species:
 - .1 Maple, to match existing.
 - .2 Veneer thickness: Minimum 1.02 mm (0.040") thick after sanding.
 - .3 Veneer cut:
 - .1 Flat cut, to match existing.
 - .4 Veneer leaf matching:
 - .1 Book.
 - .5 Veneer assembly matching:
 - .1 Balance.
 - .6 Doors in pairs or sets:
 - .1 For openings with more than one door, including doors with mullions, door faces shall be matched as follows:
 - .1 Pair matched.

2.4 Panel Materials

- .1 Panel material schedule; except where indicated otherwise:

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- .1 Thickness: 19 mm (3/4") minimum.
- .2 Core panels:
 - .1 At veneered work: Particleboard, except at shelving use veneer core plywood.
 - .2 At plastic laminate and melamine work: Particle board.
 - .3 Plywood backing; countertops, backsplashes, and where indicated: Exterior grade plywood with no added urea-formaldehyde used in composition.
- .3 Maximum moisture content at time of installation: 10% to 12%.
- .2 Melamine particleboard panels:
 - .1 Particleboard conforming to ANSI A208.1-2009, grade M3i, board consisting of 100% pre-consumer wood fibre containing no added urea-formaldehyde resins, 16 mm (5/8") 19 mm (3/4") minimum thickness with thermally fused melamine resin impregnated decorative paper facing to ANSI/NEMA LD 3-2005, complete with matching non-yellowing edge trim, unless otherwise noted.
 - .2 Melamine finish unless noted otherwise.
 - .1 Edges: Provide 3 mm (1/8") thick matching PVC edgebanding, machine applied to edges of panels in accordance with manufacturer's written recommendations unless otherwise noted.
 - .3 Colours: as selected by *Consultant*.
- .3 High pressure decorative laminate:
 - .1 General purpose grade: ANSI/NEMA LD 3-2005, Horizontal General Purpose Grade (HGS).
 - .2 Colours, finishes, and patterns: Refer to drawings.
- .4 Solid surfacing sheet:
 - .1 Homogenous (not coated, laminated or composite construction), solid colour reinforced composite material, composed of dyes, organic fibrous material, and polycarbonate/phenolic resins.
 - .1 Nominal sheet thickness: 12.7 mm (1/2") minimum, unless otherwise indicated.
 - .2 Colour: To later selection by Consultant.

2.5 Solid Core Wood Doors

- .1 Solid core doors shall be supplied in accordance with requirements of Section 08 14 00.

2.6 Fasteners and Adhesives

- .1 Fasteners shall comply with North American Architectural Woodwork Standards 3.1
- .2 Upholstery staples: Type, size, to provide sufficient strength to hold upholstered fabric taut and in place without sagging and not visible in finished work.
- .3 Concealed panel hanging strips: extruded aluminum interlocking strips. Strips and fasteners/anchors to be capable of supporting 2.5 times dead load of panels in both vertical and horizontal panel applications.

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- .4 Adhesives: Shall be used for intended purpose and manufacturer materials applications and installation, applied in accordance with manufacturer's written requirements and shall comply with the "adhesive usage guidelines" recommendations of North American Architectural Woodwork Standards 3.1

2.7 Hardware

- .1 Casework hardware; to be furnished and installed by the architectural woodwork manufacturer.
- .1 Comply with ANSI/BHMA Standards, latest edition, minimum grades, loading and other basic rules per the North American Architectural Woodwork Standards 3.1.
- .2 Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for finish number indicated.
- .1 Satin Chromium Plated: ANSI/BHMA 652 for steel base unless otherwise indicated.
- .3 Drawer Slide; Medium Duty: KV 8400; full extension; ball bearing; side mounted.
- .1 Pound Class 100.
- .2 Height: 45 mm (1-47/64 inches).
- .3 Clearance: 13 mm (1/2 inch) plus 0.8 mm (1/32 inch) minus 0 inches per side.
- .4 Cabinet hinges:
- .1 Blum 'Clip Top', Heavy Duty, concealed, 120 degree, self closing, 3-dimensional adjustment.
- .5 Cabinet door pulls: Hafele 116.05.922 Handle Aluminum. Refer to drawings for scaled or dimensioned lengths. For 24" pulls provide pulls to match.
- .6 Cabinet door bumpers: 9.5 mm diameter, 100% polyurethane door buyers with clear colour, Hafele 356.25.434.
- .7 Cabinet door and drawer locks:
- .1 Hafele 'Cam locks, FH series'
- .1 Provide cabinets locks for all cabinet doors; single key for all cabinets.
- .2 Cabinet doors in each classroom to be keyed alike.
- .2 Locks shall be master lock keyed.
- .8 Pilaster strips; Heavy Duty Pilaster Shelf Standards and Brackets:
- .1 Shelf Standard Components: Knape & Vogt Heavy-Duty 233 single-slotted channel wall standards. Surface mounted standards mounted to a suitable wall surface with mounting hardware 400 mm (16 inches) o.c.
- .2 Face: 20 mm (13/16 inch) wide by 4.8 mm (3/16 inch) deep, single slotted.
- .9 Pilaster clips: Matching pilaster finish: Knape & Vogt 256.
- .10 Cabinet clips: Richelieu, metal, satin chromium plated.
- .11 Rubber casters: Waxman 66016, 4" – Rubber Swivel Caster.
- .1 Brakes and locks: Yes.
- .2 Performance: Medium duty.
- .3 Swivel: Yes.

Architectural Woodwork

.4 Weight capacity: 300 lbs.

2.8 Finishes - Interior Architectural Woodwork

- .1 General: The entire finish of interior architectural woodwork is specified in this section, regardless of whether factory applied or applied after installation.
- .2 Preparations for finishing:
 - .1 Prior to finishing, exposed portions of woodwork shall have handling marks or effects of exposure to moisture removed with a thorough final sanding over surfaces of the exposed portions, using appropriate grit sandpaper, and shall be cleaned prior to applying sealer or finish. Sanding shall be completed just prior to stain or finishing application.
 - .2 Concealed surfaces of woodwork that might be exposed to moisture, such as those adjacent to exterior concrete or masonry walls, shall be back-primed.
 - .3 Comply with referenced quality standard in Part 1 for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.
- .3 Finish for wood veneer and solid wood :
 - .1 Comply with requirements indicated below for finish system, staining, and sheen.
 - .1 Sheen: Satin Sheen range measurements in accordance with North American Architectural Woodwork Standards 3.1.
 - .2 Factory finish with transparent, Post Catalyzed Lacquer in accordance with the North American Architectural Woodwork Standards 3.1, Section 5.
 - .1 Opaque finish: Paint or pigmented stain colour to later selection by the *Consultant*.
 - .2 Transparent finish:
 - .1 Clear (natural).

2.9 Fabrication

- .1 Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises pre-cut, where possible, to receive hardware and other items of work.
- .2 Complete fabrication, assembly, finishing, hardware application, and other work before shipment to maximum extent possible. Trial fit in shop and disassemble components only as necessary for shipment and installation. Where necessary, provide ample allowance for scribing, trimming, and fitting. Reassemble with concealed fasteners.
- .3 *Provide* woodwork, solid tops and other indicated materials with pre-cut openings, where possible, for hardware, appliances, plumbing fixtures, electrical work, telephone cut-outs and similar items. Locate openings accurately and *Provide* proper size and shape. Smooth edges of cut-outs and, where located in countertops, seal edges of cut-outs with a water-resistant coating.
- .4 *Provide* framing for architectural woodwork, complete with all bracing and fastening devices as required for a rigid installation, and as required to sustain the imposed loads.
- .5 Reinforcing shown is minimum. *Provide* additional reinforcing as required to ensure a rigid assembly. Take responsibility for the stability of furniture and fitments.
- .6 *Provide* balancing sheets as required, and specified, complying with the North American Architectural Woodwork Standards 3.1.
- .7 *Provide* surface mount blocking & strapping necessary to support the work of this section. Such blocking shall not be exposed upon completion of work.

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- .8 Prefinish work at the factory, except where specified or indicated otherwise.
- .9 Solid wood edging: No end grain shall be visible; mitre external corners; house internal corners.

PART 3 - EXECUTION

3.1 Preparation

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

3.2 Installation

- .1 Install woodwork to comply with North American Architectural Woodwork Standards 3.1 for same grade specified in Part 1 of this section for type of woodwork involved.
- .2 Install woodwork plumb, level, true, and straight with no distortions.
- .3 Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- .4 Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.
- .5 Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.

3.3 Installation - Tolerances

- .1 Install to a tolerance of 3 mm in 2400 mm (1/8" in 8'-0") for plumb and level (including tops) and with no variations in flushness of adjoining surfaces unless otherwise acceptable in accordance with the North American Architectural Woodwork Standards 3.1.

3.4 Adjusting and Cleaning

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

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3.5 Protection

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

END OF SECTION

1.1 Summary

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

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

1.4 Quality Assurance

- .1 Execute the work of this section only by a *Subcontractor* who has adequate plant, equipment and skilled workers to perform it expeditiously, is known to have been responsible for satisfactory installations similar to that specified.
- .2 Mock-Up:
 - .1 Construct panels 10 m² (100 ft²) of typical waterproofing installation for review and approval of *Consultant*. Locate at the *Place of the Work* as part of final installation.
 - .2 Do not proceed until mock-up has been reviewed and accepted by *Consultant*.

1.5 Field Conditions

- .1 Apply only when air and surface temperatures are maintained above 4°C (39°F), have been so for 48 hours, and are not likely to fall lower until the work of this section is completed, unless otherwise approved.
- .2 The work of this section may proceed at temperatures below 4°C (39°F) only with mutual documented agreement of independent inspection and testing company, manufacturer and applicator that, with materials and methods used, specified installation will be achieved.
- .3 Ensure application temperature and humidity recommended by material manufacturer are maintained before, during and after installation.
- .4 Provide forced air circulation or adequate natural ventilation during installation and curing periods for enclosed application.
- .5 Do not expose materials vulnerable to water or sun damage in quantities greater than can be installed the same day.
- .6 Install waterproofing on dry surfaces, free of snow and ice and during weather that will not introduce moisture into waterproofing system.

1.6 Delivery, Storage, and Handling

- .1 Package materials and identify on attached labels the manufacturer, contents and material specification number.
- .2 Store solvent-base liquids and surface conditioner away from excessive heat and open flame. Store surface conditioner at temperature above 5°C (41 °F).

- .3 Pallets of waterproofing membrane shall not be double stacked.

1.7 Extended Warranty

- .1 Warrant work of this section for a period of 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

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

2.2 Materials

- .1 Waterproofing membrane system; self-adhering polymeric waterproofing membrane:
 - .1 Thickness: 1.5 mm 1.5 mm (1/16").
 - .1 Film: 4 mils.
 - .2 Polymeric membrane: 56 mils.
 - .2 Tensile strength: to ASTM D412-16.
 - .1 Film: 40.71 MPa (5,900 psi) minimum.
 - .2 Polymeric membrane: 4.07 MPa (590 psi) minimum.
 - .3 Elongation: to ASTM D412-16.
 - .1 Polymeric membrane: 300 percent minimum.
 - .4 Water vapour transmission: to ASTM E96/E96M-13, Method B: 0.05 grains/ft²/hour.
 - .5 Water absorption: to ASTM D570-98(2010)e1, 0.1%, 72 hours maximum.
 - .6 Resistance to hydrostatic head: equivalent to 45.72 m (150 ft) of water.
 - .7 Puncture resistance: to ASTM E154/E154M-08a(2013)e1, 67 pounds.
 - .8 Acceptable *Products*:
 - .1 Henry 'Blueskin WP 200'.
 - .2 Colloid Environmental Technologies Company (CETCO) 'Envirosheet', as distributed by DRE Industries Inc.
 - .3 GCP Applied Technologies 'Bituthene 3000' and 'Bituthene Low Temperature'.
 - .4 IKO 'AquaBarrier FP'.
 - .5 Soprema 'Colphene 3000'.
 - .6 W.R. Meadows 'Mel-Rol'.
- .2 Primer/surface conditioner: In accordance with membrane manufacturer's written installation requirements.
- .3 Bonding asphalt: Single component bonding asphalt. Use manufacturer's proprietary mastic.
- .4 Mastic; self-adhered membrane systems: Single component, utility grade, rubber based sealant. Use manufacturer's proprietary mastic.

PART 3- EXECUTION

3.1 General

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

3.2 Preparation - Typical

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

3.3 Vertical Membrane Installation

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

3.4 Protection Course

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

3.5 Field Quality Control

- .1 Field tests and inspections:
 - .1 Upon completion of the work of this section, have entire installation inspected by membrane manufacturer's authorized representative in the presence of *Consultant*.

END OF SECTION

Thermal Insulation

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Semi rigid insulation, metal siding wall insulation
 - .2 Rigid insulation board; masonry wall insulation.
 - .3 Foamed-in-place (gap filler) filler insulation.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting.
Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

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

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Execute work of this section using a *Subcontractor* who has adequate plant, equipment and skilled workers to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified.

PART 2- PRODUCTS

2.1 Insulation Materials

- .1 Semi-rigid insulation board:
 - .1 Mineral-fibre to CAN/ULC S702-14, Type 1, either dual density or mono density.
 - .1 Dual density:
 - .1 Outer layer: 100 kg/m³ (6.25 lb/ft³) to ASTM C612-14.
 - .2 Inner layer: 65 kg/m³ (4.1 lb/ft³) to ASTM C612-14.
 - .2 Acceptable *Products*:
 - .1 Rockwool 'CavityRock'.
 - .2
- .3 Rigid insulation board; masonry wall assemblies:
 - .1 Extruded polystyrene to CAN/ULC S701.1-17, Type 3:

Thermal Insulation

- .2 Acceptable *Products*:
 - .1 DuPont 'CavityMate'.
 - .2 Owens Corning 'Foamular C-200'.
 - .3 Soprema 'Sopra-XPS-20'.
- .4 Flexible low expansion polyurethane foam; for thermal insulation around exterior framing assemblies (gap filler):
 - .1 Single-component, high performance, gun-grade polyurethane flexible foam that performs as a thermal barrier. With an industry leading movement range of +/-15% (Movement Accommodation Factor of 30%).
 - .2 Acceptable *Products*:
 - .1 Geocel 'Airblock'.
 - .2 Tremco ExoAir Flex Foam.

2.2 Accessories

- .1 Insulation fasteners: HDPE washer, zinc plated pin finish, pins purpose made to suit substrate material, 50 mm (2") minimum insulation holding diameter; direct fasten type, pin depth length to suit insulation thickness.
 - .1 Acceptable *Products*:
 - .1 ITW Construction Products Ramset 'InsulFast'.

PART 3- EXECUTION

3.1 Installation - General

- .1 Install insulation in accordance with manufacturer's written requirements applicable to products and applications indicated.
- .2 Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- .3 Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- .4 Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
- .5 Install attachment at rate as required to prevent displacement of insulation boards during construction operations.
- .6 Butt joints tightly and offset vertical joints to form an unbroken thermal envelope. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .7 Apply insulation to ensure total and complete coverage of surfaces indicated to be insulated, and in direct contact with such surfaces.
- .8 Ensure integrity and continuity of insulation at juncture with different types of materials and seal in an acceptable manner.
- .9 Do not cover insulation until it has been reviewed and accepted by *Consultant*.

Thermal Insulation

3.2 Installation - Rigid Insulation

- .1 Edge butter rigid insulation joints with adhesive and trowel flush with insulation face at wall cavity insulation locations.
- .2 Butter masonry tie penetrations with adhesive at wall cavity insulation locations.
- .3 Apply insulation boards with board joints staggered and offset between insulation layers; mechanically fastened to substrate with minimum of 5 insulation fasteners per insulation board and maximum spacing of 610 mm (24") on centre.

3.3 Installation - Semi-Rigid Insulation

- .1 Mechanically fasten to substrate with minimum of 5 insulation fasteners (dice pattern) per insulation board and maximum spacing of 610 mm (24") on centre.
- .2 Position fasteners 75 mm (3") from insulation board edges.

3.4 Installation - Below-Grade Rigid Insulation

- .1 On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written requirements.
- .2 On horizontal surfaces, loosely lay insulation units according to manufacturer's written requirements. Stagger end joints and tightly abut insulation units.
- .3 Concrete faced below grade perimeter foundation insulation:
 - .1 Install concrete faced insulation using corrosion resistant concrete fasteners and clips, required clips in accordance with manufacturer's written requirements.
 - .2 Extend panels to minimum 150 mm (6") below finished grade unless otherwise indicated.
 - .3 Layout concrete faced insulation boards to maximize board sizes. Do not use boards less than 305 mm (12") wide. Orient boards vertically.
 - .4 Apply sealant around penetrations in accordance with Section 07 92 00.
 - .5 Mitre external corners and maintain consistent jointing.
 - .6 Install corner and other related flashing in accordance with Section 07 62 00.

3.5 Installation - Foamed-in-Place (Gap Filler) Insulation

- .1 Install one-component foam insulation to fill gaps where indicated, in accordance with CAN/ULC S710.2-11 application standard.

3.6 Field Quality Control

- .1 Conduct quality control.
 - .1 Independent inspection and testing company shall:
 - .1 Perform inspection for completed work.
 - .2 Perform thickness verification.

3.7 Protection

- .1 Comply with manufacturer's written requirements respecting protection.
- .2 Protect polystyrene insulation from extended exposure to sunlight.

Thermal Insulation

- .3 Repair damage resulting from performance of work of this section in manner acceptable to *Consultant*.

END OF SECTION

Perimeter Base Insulation

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Perimeter base insulation system, located above grade.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate installation and cooperate with sealant trades.
- .2 Conduct a pre-installation meeting.

1.3 Submittals

- .1 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .2 Shop drawings:
 - .1 Submit drawings showing layout of work of this section and locations and details flashing conditions.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Subcontractors:
 - .1 Execute the work of this section only by a specialized Subcontractor with equipment and skilled workers trained by manufacturer supplying products to this section, and is known to have been responsible for satisfactory work similar in size and class to that specified.
 - .1 Applicators shall be trained and certified by proposed system manufacturer.
 - .1 Submit signed letter from system manufacturer certifying Subcontractor for work of this section.
 - .2 Installation of systems specified in this section to be by a single Subcontractor.

1.5 Field Conditions

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

1.6 Delivery, Storage, and Handling

- .1 Deliver materials in the original, unopened packages with labels intact. Upon arrival, inspect materials for damage, and manufacturer informed of any discrepancies.
- .2 Store materials in a cool, dry location, out of sunlight, protected from weather and other damage in accordance with manufacturer's specifications.

Perimeter Base Insulation

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36 for a period of 5 years.
- .2 Repair or replace acrylic texture parging finishes that fail within the specified warranty period. Failures shall include delaminating or debonding of coats to substrates or one another, and failure to maintain weathertightness.

PART 2 - PRODUCTS

2.1 Manufacturers

- .1 Specifications are based on Durabond Products Ltd.
 - .1 Perimeter base coating: DuRock 'B2000'.
- .2 The following listed manufacturers are acceptable only when in compliance with requirements of this section.
 - .1 Adex Systems Inc.
 - .2 Akrilon Inc.
 - .3 BASF.
 - .4 DuRock Alfacing International.
 - .5 Dryvit Canada.

2.2 Performance/Design Requirements

- .1 Design and construct work of this section in accordance with building code and the following performance/design requirements:
 - .1 Standard for Exterior Insulation and Finish Systems (EIFS) – Materials and Systems: CAN/ULC-S716.1.
 - .2 Fire endurance tests; in accordance with building code classification, and limiting distance where applicable:
 - .1 CAN/ULC S134-13 or CAN/ULC S101-14.
 - .3 Install standard and high impact mesh at all locations.
 - .4 Joints:
 - .1 *Provide* weather-tight sealant joints for work of this section.
 - .1 Dual barrier sealant system.
 - .2 Joint width: 19 mm (3/4") wide joints, unless otherwise indicated.

2.3 Perimeter Base Coating and Insulation System

- .1 Perimeter base coat: DuRock 'B2000'.
 - .1 Impact resistance: Basecoat shall include standard and high impact reinforcing mesh to meet Ultra High Impact Resistance in accordance with ASTM E 2486, in accordance with manufacturer's written requirements.
 - .2 Acceptable Product:
 - .1 High impact reinforcing mech: DuRock Fiberglass mesh for parging

Perimeter Base Insulation

- .2 Insulation: Type II Expanded Polystyrene (EPS), CAN/ULC S701.1-17, 138 kPa (20 psi) compressive strength.
- .3 Adhesive for attachment of insulation and protection board: in accordance with manufacturer's written requirements for system specified. Adhesive shall be in accordance with waterproofing manufacturer's written requirements for system specified.

PART 3- EXECUTION

3.1 Examination

- .1 Ensure environmental and Place of the Work conditions are suitable for installation of system. Verify surface conditions with the manufacturer.
- .2 Examine surfaces to receive membrane to ensure they are smooth, dry, and free from conditions that will adversely affect execution, permanence, adhesion or quality of work. Do not proceed with work until substrate and conditions for work are acceptable.

3.2 Preparation

- .1 Prepare substrate surfaces in accordance with manufacturer's written requirements.
- .2 Protect adjacent surfaces from damage resulting from work of this section.
- .3 Protect finished work at end of each day or on completion of each section of work from water penetration.
- .4 Protect completed installation from moisture for 48 hours minimum.
- .5 Reinforce substrate joints, cracks, cold joints, with joint tape set with basecoat material.
- .6 Commencement of application over substrate shall imply acceptance of substrate conditions.

3.3 Installation

- .1 Apply materials in accordance with manufacturer's written requirements.
- .2 Where manufacturers' written requirements are not available, or a situation is ambiguous or unique, consult the manufacturer's technical representative and the Consultant at the Place of the Work to review the situation and make clarifications. Requirements shall be confirmed in writing by the Consultant and/or manufacturer.
- .3 Commencement of application over substrate shall imply acceptance of substrate conditions.
- .4 Do not apply sealant directly to textured finishes or base coat surfaces.
- .5 Joint sealants:
 - .1 Provide sealant to joints within finish system, including joints where finish system interfaces with other adjacent materials and assemblies.
 - .2 Sealants shall be installed after completion of basecoat, and before installation of finish coat, in accordance with Section 07 92 00. This section shall be responsible for workmanship of sealants applied to work of this section.

3.4 Special Conditions

- .1 Stop and start work at natural breaking points, such as internal and external corners, openings, and expansion joints.

END OF SECTION

Air Barrier Systems

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Sheet-applied self-adhesive vapour impermeable air / vapour /weather barrier membrane.

1.2 Administrative Requirements

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .2 Compatibility statement:
 - .1 Submit manufacturer's compatibility statement validating compatibility of air barrier system materials with substrates and adjacent materials.
- .3 Samples:
 - .1 Submit 305 mm (12") square samples of each type of air barrier membrane.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .2 *Provide* the work of this section, executed by competent installers with experience in application of *Products*, systems and assemblies specified.

1.5 Delivery, Storage, and Handling

- .1 Package materials and identify on attached labels the manufacturer, contents and material specification number.
- .2 Store flammable solvent-base liquids away from excessive heat and open flame. Primer contains solvent. Do not use near open flame.
- .3 Store surface conditioner at temperature above 5°C to facilitate handling.
- .4 Store roll materials on end.

1.6 Field Conditions

- .1 *Provide* forced air circulation during curing period for enclosed applications.
- .2 Low temperature application:
 - .1 Perform adhesion test for membrane when ambient temperature is below -5°C.
 - .2 Proceed with work when temperature is (or predicted) to fall below -5°C ambient temperature only with the mutual documented agreement of inspection and testing company, manufacturer and applicator.
- .3 Do not perform installation during rainy or inclement weather or on wet or frost covered surfaces.

Air Barrier Systems

- .4 Provide temporary protection of the applied membrane to prevent mechanical damage or damage from spillage of oil or solvents.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Air barrier system shall perform as continuous air barrier and as liquid-water drainage plane flashed to discharge to exterior of building envelope incidental condensation or water penetration.
- .2 At wall and roof cladding transitions, air barrier system shall perform as continuous air barrier and as liquid-water drainage plane flashed to discharge to exterior of building envelope incidental condensation or water penetration by creation of unobstructed drainage plane that extends across the cladding transition or by flashing to discharge to exterior of building envelope incidental condensation or water penetration.
- .3 Air barrier system shall accommodate substrate movement, construction material changes, and transitions at perimeter conditions without deterioration which permits air and water leakage exceeding the following specified limits and requirements, or interruption of the drainage plane:
 - .1 Air permeance of air barrier material: Maximum 0.02 L/s.m² at 75 Pa (0.004 cfm/ft² at 1.57 psf) to ASTM E2178-13.
 - .2 Rate of air leakage of air barrier system: Maximum 0.10 L/s.m² at 75 Pa (0.020 cfm/ft² at 1.57 psf) to ASTM E283-04.
 - .3 Water vapour transmission for air / vapour barriers: Maximum 5.7 ng/Pa.m².s. (0.1 perms).
 - .4 Water vapour transmission for vapour permeable air vapour barriers: Minimum 570 ng/Pa.m².s. (10 perms).
 - .5 Air barrier system structural performance while maintaining air barrier performance for air leakage: Air barrier system shall transfer wind loads to structure and shall resist design wind load in accordance with the building code.
 - .6 Low temperature performance: Minimum -30°C (-22°F).
 - .7 Compatibility: Air barrier system materials shall be compatible with substrate and adjacent materials with material manufacturers and show no performance deterioration during service conditions.
 - .8 Self-sealability: ASTM D1970/D1970M-18.
 - .9 Adhesion: ASTM D4541-17, 110 kPa (16 psi) minimum performance for site tested adhesion.
- .4 Air barrier system shall be joined in an airtight, watertight, and flexible manner to air barrier material of adjacent building envelope air barrier systems, allowing for relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between the following unless otherwise applicable:
 - .1 Foundation and walls.
 - .2 Walls and openings (windows, doors, louvres, and other wall penetrations).
 - .3 Wall and roof systems.
 - .4 Wall and roof over unconditioned space.
 - .5 Walls, floor and roof across construction, control, and movement joints.
 - .6 Walls, floors and roof to utility, pipe and duct penetrations.

Air Barrier Systems

2.2 Materials - General

- .1 Single source responsibility: Materials shall be sourced from one manufacturer including sheet membranes, air barrier sealants, primers, mastics and adhesives.

2.3 Sheet-Applied, Vapour Impermeable Self-Adhesive Air / Vapour / Weather Barrier Membrane System

- .1 Description: Composite preformed modified bituminous membrane system consisting of SBS modified asphalt for low temperature flexibility and polyethylene scrim reinforcing, with physical properties as follows:
 - .1 Thickness: 1.0 mm (40 mils).
 - .2 Application temperature: in accordance with manufacturers written requirements.
 - .3 Primer: in accordance with manufacturers written requirements.
 - .4 Termination and penetration sealing mastic: in accordance with manufacturers written requirements.
 - .5 Acceptable product systems:
 - .1 Carlisle Coatings & Waterproofing 'CCW 705'.
 - .2 GCP Applied Technologies 'Perm-A-Barrier Wall Membrane'.
 - .3 Henry Company 'Blueskin SA' and 'Blueskin SA LT'.
 - .4 IKO 'AquaBarrier AVB' and AquaBarrier AVB Low Temp'.
 - .5 Soprema 'Sopraseal Stick 1100 T'.
 - .6 Tremco 'ExoAir 110 and 110LT'.
 - .7 W.R. Meadows 'Air Shield' and 'Low Temperature Air Shield'.

2.4 Transition membrane

- .1 Air barrier materials; transition from glazing system air barrier and tying into building envelope air barrier systems:
 - .1 Silicone sheet air barrier membrane and manufacturer's recommended sealants and accessories:
 - .1 Air barrier transition system to resist specified design loads when subjected to uniform load deflection test in accordance with ASTM E330/E330M-14.
 - .2 Air barrier transition system to allow no water penetration in accordance with ASTM E331-00(2016) to a design pressure not less than 720 Pa (15 psf).
 - .3 Acceptable *Products*:
 - .1 Tremco 'Proglaze ETA Engineered Transition Assembly'.

2.5 Through wall flashing:

- .1 Sheet membrane:
 - .1 Single source responsibility: Components required for complete air barrier system and through wall flashing membrane behind the opaque wall assemblies to be obtained from single manufacturer. Coordinate with Section 07 27 00.
 - .2 Primer: as per manufacturer's installation requirements.

Air Barrier Systems

- .3 SBS rubberized asphalt compound integrally laminated to cross laminated polyethylene film.
- .4 Acceptable Products:
 - .1 Carlisle Coatings & Waterproofing: CCW-705 TWF.
 - .2 GCP Applied Technologies 'Perm-A-Barrier Wall Flashing'.
 - .3 Henry Company 'Bakor Blueskin TWF'.
 - .4 Soprema 'Sopraseal Stick 130-S'.
 - .5 Tremco 'ExoAir TWF'.
 - .6 W.R. Meadows 'Air-Shield Thru-Wall Flashing'.

PART 3- EXECUTION

3.1 Installation - General

- .1 Surfaces to receive air barrier systems shall be smooth, dry and free from conditions that will adversely affect execution, permanence, or quality of the work of this section.
- .2 Air barrier system shall be continuous in the building envelope. Lap and seal air barrier systems in accordance with product manufacturer's written installation requirements to construction, control, and expansion joints, across junctions between different building assemblies, and around penetrations through the building assembly.
- .3 At movement joints and locations where back side of membrane is exposed to air gaps loop membrane into opening to allow for movement. Provide polyethylene film or other approved material to the substrate face of the membrane loop in accordance with manufacturer's written installation requirements.
- .4 Wrap into jamb, head and sill of building envelope window openings, door openings, and other openings with air barrier system membrane by returning membrane to inside face of opening unless otherwise indicated.
 - .1 Coordinate air / vapour barrier terminations of work of this section with air / vapour barrier membrane in Section 08 44 00.

3.2 Installation - Sheet-Applied, Self-Adhesive Membrane

- .1 Apply self-adhering membrane continuous to prepared and primed substrate in an overlapping shingle fashion to shed moisture towards exterior and in accordance with manufacturer's written requirements.
- .2 At the end of each days work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.
- .3 Apply self-adhering membrane continuous across junctions between different building assemblies, and around penetrations through the building assembly. Provide overlap in accordance with manufacturer's written requirements.
- .4 Inspect membrane for punctures, misaligned seams and fishmouths, apply additional layer of membrane over affected area .

Air Barrier Systems

- .5 Apply membrane continuous across junctions between different building assemblies, and around penetrations through the building assembly. Provide overlap in accordance with manufacturer's written requirements. Where adjacent air barrier or other building material is sensitive to damage by heat required for application, provide transition membrane which is compatible with thermofusible membrane and adjacent building material in accordance with manufacturer's written requirements.

3.3 Installation- Flexible Flashing

- .1 Install metal drip edges beneath flexible flashing. Stop flexible flashing 12.7 mm (1/2") back from outside face of wall and adhere flexible flashing to top of metal drip edge

3.4 Field Quality Control

- .1 Provide Manufacturer's field review.

END OF SECTION

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Prefinished metal siding system.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate with installers of wall mounted items, equipment, and mechanical and electrical work so that installation will not subvert the integrity of the cladding system.
 - .2 Coordinate interface, transition, lapping, flashings and compatibility of membranes with work of Section 07 27 00.
- .2 Conduct a pre-installation meeting.

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .2 Letters of general conformity:
- .3 Shop drawings:
 - .1 Submit engineered shop drawings.
 - .2 Indicate dimensions, cladding profiles, attachment and anchoring materials and methods, trim and closure pieces, fascia, material finishes and colours, and related work.
 - .3 Indicate methods to achieve watertight assembly, including sealants, penetration seals, drainage path of moisture from within assembly to exterior of envelope.
- .4 Samples:
 - .1 Submit 2 - 610 mm x 610 mm (24" x 24") size samples of cladding materials, of each colour and profile specified for approval by Consultant.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors: Execute the work of this section only by a *Subcontractor* who has adequate equipment, and skilled workers to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past 5 years.
 - .2 Aspects of the work of this section are required to be prepared by a professional engineer. Refer to Section 01 33 00 for specific details and requirements in this regard.

1.5 Delivery, Storage, and Handling

- .1 Store materials at temperatures recommended by manufacturer.
- .2 Store bundles of panels raised on pallets, and sloped to drain.

Metal Cladding Systems

- .3 Package materials and identify on attached labels the manufacturer, contents and material specification number.
- .4 Store flammable solvent-base liquids away from excessive heat and open flame. Primer contains solvent. Do not use near open flame.

1.6 Field Conditions

- .1 Comply with CSSBI's installation requirements.

1.7 Extended Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36 for a period of 2 years.
- .2 The warranty is a total system warranty. The metal cladding system shall meet both the specified system and the building envelope performance requirements during the warranty period.

PART 2- PRODUCTS

2.1 Manufacturer

- .1 Acceptable manufacturers:
 - .1 Agway Metals Inc.
 - .2 Duchesne.
 - .3 Flynn Canada Ltd.
 - .4 Roll Form Group.
 - .5 Vicwest.

2.2 Performance/Design Requirements

- .1 Design to CAN/CSA S136-16 and building code.
- .2 Design for expansion and contraction of component materials of the *Work* produced by an exterior surface temperature range of -35°C to +60°C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .3 Design cladding system to accommodate and withstand the following without permanent deformation or damage to, or failure of, cladding system or building structure:
 - .1 Deflection of cladding system due to uniformly distributed specified loads shall not exceed L/90 of the span for walls, nor L/180 of the span for roofs.
 - .2 Movement within cladding system, and between cladding system and building structure.
 - .3 Cladding system dead loads, snow loads, ice loads, and wind loads, and combinations thereof, in accordance with the building code.
 - .1 Design wind loads shall be based on at least 1/50 hourly wind pressure values as indicated in building code and greater values as required, and to cladding design wind loads indicated in wind study report, to maximum allowable deflection without permanent deformation.
- .4 Design to allow positive drainage of condensation occurring within cladding system to exterior of building envelope or drainage outlet.
- .5 Design to allow positive drainage of water to exterior of building envelope or drainage outlet.

Metal Cladding Systems

- .6 Design metal systems to the Architectural Sheet Metal Manual by SMACNA unless otherwise indicated.
- .7 Design wall system and secondary support structure to accommodate specified erection tolerances of the structure.
- .8 Design system to meet tolerances specified.

2.3 Materials

- .1 Preformed steel cladding; fabricated from preformed sheet metal as follows:
 - .1 Metal sheet:
 - .1 Zinc coated sheet steel: sheet steel to ASTM A653/A653M-13 with coating designation Z275 (G90) to ASTM A924/A924M-18 unless otherwise indicated.
 - .2 Preformed metal thickness:
 - .1 0.91 mm (20 gauge) base steel nominal thickness.
 - .2 Accessories and hardware: Zinc coated steel to meet specified requirements of ASTM A123/A123M-13, hot dip galvanized after fabrication.
 - .3 Acceptable profile:
 - .1 CL439 by VicWest
 - .2 Or similar profile to match
 - .4 Colour to match existing adjacent to remain.
 - .2 Thermally broken façade substructure:
 - .1 System shall provide façade substructure with the following attributes:
 - .1 Thermally broken.
 - .2 Meet requirements of the building code for non-combustible construction.
 - .3 Adjustable to permit façade alignment tolerances.
 - .4 Corrosion resistant performance.
 - .5 Suitable for rear ventilated rain screen façade design.
 - .2 Z-girt and sub-girts: Preformed Z275 galvanized metal sheet, 1.22 mm (18 gauge) minimum base steel nominal thickness, notched for drainage, to ASTM A653/A653M-13, Grade A.
 - .3 Thermally broken spacer systems:
 - .1 Subject to compliance with the requirements of the *Contract Documents*, provide one of the following product systems:
 - .1 Northern Facades 'ISO Clips'
 - .2 Cascadia Windows & Doors 'Cascadia Clip'.
 - .3 SFS 'Nvelope System Brackets'.
 - .3 Sub-girts (z-girts): minimum 1.2 mm (18 gauge) zinc-coated steel to ASTM A653/A653M-13 with Grade A coating Z275.
 - .1 Adjustable.

Metal Cladding Systems

- .2 Thermal breaks at structural steel substrates: 3 mm (1/8") thick natural cork or neoprene.
- .4 Accessories: exposed trim, end and flute closures, cap pieces, flashings, and the like, of same metal material and finish, and colour as prefinished metal panels, unless otherwise indicated.
- .5 Insulation:
 - .1 Semi-rigid in accordance with Section 07 21 00.
- .6 Air barrier membrane: in accordance with Section 07 27 00.
- .7 Exposed sealants: in accordance with Section 07 92 00.
- .8 Gaskets: soft, pliable, cold weather grade, PVC foam, extruded profile for outer sheet.
- .9 Fasteners:
 - .1 Self-drilling, Type 304 stainless steel.
 - .2 Head finish:
 - .1 Type 304 stainless steel, in concealed locations.
 - .2 Prepainted metal for profile 2 metal siding, colour to match prefinished metal panels in exposed locations.
 - .3 Nylon head, colour to match prefinished metal panels in exposed locations.

2.4 Metal Finishes

- .1 Prefinished sheet finish:
 - .1 Painted finish: Shop finish in accordance with 09 91 00

2.5 Fabrication

- .1 Form to profiles indicated on drawings and to conform to reviewed shop drawings.
- .2 Construct panel lines, breaks, and angles sharp and true, and surfaces free from warp and buckle.
- .3 Allow for structural movements within the systems, and to accommodate thermal expansion and contraction between panels and structural members.
- .4 Ensure that metal panels are free of steel contamination from rollers.
- .5 Fabricate siding panel systems to prevent entry of water into building and from collection within system assembly.
- .6 Join intersecting parts together to provide tight, accurately fitted joints with adjoining surfaces in true planes.
- .7 Fabricate formed and notched metal closures to close-off flutes at exterior. Seal also with neoprene foam filler.
- .8 Cooperate with applicable sections to ensure coordination required for proper installation of work of this section in conjunction with and incorporated with other work.
- .9 Fabricate metal cladding panels in one length; maximum 6000 mm (20') for horizontal application; 12000 mm (40') for vertical application; unless otherwise indicated.
- .10 Prefinished metal panel terminations shall not have a raw metal edge or exposed fasteners. Panel ends for non-corrugated panels shall be folded.

Metal Cladding Systems

- .11 Fabricate flashings used in conjunction with the metal roof with S-locks for concealed fastening unless otherwise specified.

PART 3- EXECUTION

3.1 Examination

- .1 Take measurements at the *Place of the Work* to ensure that the work of this section is fabricated to fit structure, surrounding construction, around obstructions and projections in place.
- .2 Verify that backup construction is aligned for proper installation of prefinished metal panel system before commencing erection.

3.2 Air Barrier Membrane Application

- .1 Install in accordance with manufacturer's written installation requirements and in accordance with Section 07 27 00.
- .2 Surfaces must be smooth, clean dry and free from loose contaminants. Brushing and/or scraping of block and concrete surfaces may be required to adequately prepare surface.
- .3 Apply primer for membrane work.
- .4 Wrap openings with membrane returning to inside face of openings.
- .5 Ensure air barrier seals into adjacent systems for complete air barrier to building envelope.
- .6 Seal around materials penetrating membrane in accordance with manufacturer's written requirements.

3.3 Air Barrier

- .1 Prime substrates and install membrane in accordance with membrane manufacturer's written installation requirements.
- .2 Provide membrane laps in accordance with manufacturers written requirements.
- .3 Eliminate wrinkles or gaps, roll entire membrane surface (including seams) with a counter top or "J-roller" to ensure full contact and adhesion.
- .4 Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the air barrier membrane and around the perimeter edge of membrane terminations.
- .5 Flashing membrane shall be applied in weatherboard fashion, in and around the full perimeter of openings, to provide water tight protection and according to the following procedures:
 - .1 Apply the first strip horizontally immediately below the sill, cut it sufficiently long to extend past each side of the window, so that it projects even with the vertical jamb flashing to be applied later. Turn sill flashing up at ends of sill.
 - .2 Sill flashing shall overlap wall membrane. Overlap jamb at head flashing membrane in the same manner.

3.4 Insulation

- .1 Install insulation in accordance with manufacturer's written installation requirements and in accordance with Section 07 21 00.
- .2 Cut backs of pieces as required to fit over projecting anchors, fastenings or similar protrusions. Fit boards with tight joints around obstructions, openings, corners, and structural members.

Metal Cladding Systems

- .3 Apply insulation to ensure total and complete coverage of surfaces indicated to be insulated, and in direct contact with such surfaces.
- .4 Use largest possible dimensions to reduce number of joints.

3.5 Cladding System Installation

- .1 Erect systems complete with flashings forming part of the system, clips, fasteners, closures and sealant to meet same design criteria as specified for fabrication.
- .2 Erect panels in straight lines that are true, level, square, and plumb to comply with installation tolerances.
- .3 Attachment system: Allow for free and noiseless vertical and horizontal thermal movement due to expansion and contraction for material temperature range. Buckling of panels, opening of joints, undue stress on fasteners, failure to sealants or any other detrimental effects due to thermal movement is not permitted. Allow for ambient temperature at time of fabrication, assembly and erection procedures.
- .4 Anchor cladding securely per engineering recommendations and in accordance with reviewed shop drawings to allow for necessary thermal movement, wind loading and structural support.
- .5 Install sealant between work of this section and work of other sections to meet specified requirements of Section 07 92 00 and to provide a watertight installation.
- .6 Cut, flash, and apply sealant to system penetrations. Seal around materials penetrating metal cladding watertight.
- .7 Install various components within cladding assembly to provide positive controlled drainage of moisture to exterior of building envelope or drainage outlet.
- .8 Conceal fasteners.
- .9 Do not install component parts that are observed to be defective, including warped, bowed, dented, and broken members.
- .10 Obtain panel symmetry whenever possible relative to openings in both vertical and horizontal plane.
- .11 Break form metal flashings to profile required, in maximum lengths.
- .12 Install head and sill flashings, edge trim, cap pieces and other formed profiles as applicable and detailed.
- .13 Apply sealant to face of supports for top and bottom closure flashings and at supports for perimeter closure flashings and returns.

3.6 Metal Cladding Installation Tolerances

- .1 Maintain the following installation tolerances:
 - .1 Maximum variation from plane or location shown on reviewed shop drawings: 20 mm (3/4")/10 m (32.8') of length and up to 30mm (1-1/6")/100 m (328') maximum.
 - .2 Maximum offset from true alignment between two adjacent members abutting end to end or side-by-side, in line: 1 mm (0.039").
 - .3 Flatness: Maximum deviation from flatness shall be 3.2 mm (1/8") in 1520 mm (5') on panel in any direction for assembled units.

3.7 Adjusting and Cleaning

- .1 After erection, touch up coatings removed or damaged during erection.

Metal Cladding Systems

- .2 Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new.
- .3 Wash down exposed interior and exterior surfaces using solution of mild domestic detergent in warm water, applied with soft clean wiping cloths. Wipe interior surfaces clean as part of final clean-up.
- .4 Remove excess sealant with recommended solvent.

3.8 Protection

- .1 Protect prefinished steel during fabrication, transportation, storage at the *Place of the Work* and erection, in accordance with CSSBI Standards.

END OF SECTION

Metal Flashing

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Supply and installation of prefinished metal (steel) flashings.
 - .2 Supply and installation of gravel stops.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting.

1.3 Submittals

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

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors: *Provide* work of this section, executed by competent installers with record of successful install in application of *Products*, systems and assemblies specified and with approval of *Product* manufacturers.

Metal Flashing

- .1 Sealant shall be applied by a *Subcontractor* with proven experience in this type of work, and who has the necessary equipment and skilled mechanics to carry out the work of this section satisfactorily and can substantiate this to satisfaction of *Consultant*.
- .2 Quality standards:
 - .1 Quality of fabrication and installation of sheet metal work shall comply with recommendations published by National Roofing Contractors Association.

1.5 Delivery, Storage, and Handling

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

1.6 Extended Warranty

- .1 Warrant work of this section for a period of 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Design members to withstand wind loads as calculated in accordance with the building code and to cladding design wind loads indicated in wind study report, to maximum allowable deflection without permanent deformation.

2.2 Prefinished Steel Flashing

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

2.3 Prefinished Metal Finishes

- .1 Provide the following finish to exposed prefinished steel:
 - .1 Finish: factory prefinished CSSBI 10000 Series.
 - .1 10000 Series (Polyvinylidene Fluoride - PVDF) will not visibly (within 10 metres to the unaided naked eye) crack, chip, or peel (lose adhesion) for thirty-five (35) years from date of application. This does not include minute fracturing that may occur during the normal fabrication process. 10000 Series (Polyvinylidene Fluoride - PVDF) will not chalk in excess of a number eight (8) rating, in accordance with ASTM D4214-07(2015) method D659 at any time for thirty (30) years; will not change colour more than five (5.0) Hunter ΔE units as determined by ASTM D2244-16 at any time for thirty (30) years.
 - .2 Colour to later selection by *Consultant* from manufacturer's full range.

2.4 Accessories

- .1 Isolation coating: to CAN/CGSB-1.108, bituminous type.
- .2 Sealants:

Metal Flashing

- .1 Exposed sealants: Silicone in accordance with Section 07 92 00, colour as selected by *Consultant* from manufacturer's full range.
- .2 Concealed flashing sealants; hooked-type expansion joints with limited movement: Butyl sealant to ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied.
- .3 Cleats: of matching metal to flashing material, continuous, and of greater thickness than flashing material. Offset joints in cleats 305 mm (12") with joints in perimeter edge metal. Allow a 12.7 mm (1/2") gap between pieces.
- .4 Fasteners:
 - .1 Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - .2 General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head:
 - .1 Exposed screws: 38 mm (1-1/2") long minimum at 450 mm (18") on centre maximum. Heads matching colour of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM washer under heads of exposed fasteners.
 - .2 Blind fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - .3 Cleat fasteners: Corrosion-resistant barbed angular ring or screw shank nail; length to achieve approximately 32 mm (1-1/4") penetration into nailer.
 - .3 Fasteners for prefinished galvanized steel sheet: hot dip galvanized steel to ASTM A153/A153M-09 and ASTM A653/A653M-13 Class G185.
 - .4 Fasteners for galvanized steel sheet: hot dip galvanized steel to ASTM A153/A153M-09 and ASTM A653/A653M-13 Class G185.
 - .5 Fasteners and plates to meet the requirements of FM 4470-12 for wind uplift and corrosion resistance.
- .5 Flexible flashing membrane; high temperature grade for use at locations where membrane is not protected by insulation:
 - .1 Description:
 - .1 Thickness: 0.76 mm (30 mils) minimum.
 - .2 Self-adhesive grade rubberized membrane backed by high density polyethylene.
 - .3 Primer for substrate.
 - .4 High temperature grade to resist softening at 105°C minimum.
 - .2 Acceptable *Products*:
 - .1 Henry 'Blueskin PE 200 HT'.
 - .2 Firestone 'Clad-Gard SA'.
 - .3 GCP Applied Technologies 'Ultra'.
 - .4 Soprema 'LASTOBOND SHIELD HT'.
- .6 Flexible flashing membrane; standard temperature grade for use at locations where membrane is protected by material with insulating properties:
 - .1 Description:

Metal Flashing

- .1 Thickness: 1 mm (40 mils) minimum.
- .2 Self-adhesive grade rubberized membrane backed by high density polyethylene.
- .3 Primer for substrate.
- .2 Acceptable *Products*:
 - .1 Henry 'Blueskin Roof RF200'.
 - .2 GCP Applied Technologies 'Ice & Water Shield'.
 - .3 Soprema 'LASTOBOND SHIELD'.

2.5 Fabrication

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable NRCA Roofing Manual: Membrane Roof Systems 2011, details and as indicated.
- .2 Fabricate metal flashings and other sheet metal work in accordance with applicable SMACNA "Architectural Sheet Metal Manual (Seventh Edition) details and as indicated.
- .3 Form pieces in 3048 mm (10 ft) maximum lengths. Make allowance for expansion at joints.
- .4 Sealed joints: Form non-expansion but movable joints in metal to accommodate sealant.
- .5 Expansion provisions: Form expansion joints of intermeshing hooked flanges, not less than 25.4 mm (1") deep, filled with butyl sealant concealed within joints.
 - .1 Joints that provide expansion and contraction capabilities should be located near the corners within approximately 610 mm (24") from each direction of the corner measured from the interior side.
- .6 Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, and of greater thickness of metal being secured.
- .7 Hem exposed edges on underside 12.7 mm (1/2"). Mitre and seal corners with butyl sealant.
- .8 At parapets, provide 25.4 mm (1") minimum overlap between bottom of wood blocking or flashing anchorage support and edge of drip or termination of flashing.
- .9 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .10 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.
- .11 Provide 25.4 mm (1") minimum overlap between bottom of wood blocking or flashing anchorage support and edge of drip or termination of flashing.
- .12 Shop fabricate inside and outside corners.

PART 3- EXECUTION

3.1 Flexible Flashing Underlayment Installation

- .1 Apply primer to concrete masonry and precast concrete substrates.
- .2 Install in a consecutive weatherboard method starting at bottom or base of wall and working up.
- .3 *Provide* minimum of 50 mm (2") side laps and 75 mm (3") end laps.
- .4 Cut to manageable lengths, position membrane for alignment, remove protective poly-film and firmly apply pressure to assure adhesion.

Metal Flashing

- .5 Eliminate wrinkles or gaps, roll entire membrane surface (including seams) with a counter top or "J-roller" to ensure full contact and adhesion.
- .6 Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the air barrier membrane and around the perimeter edge of membrane terminations.
- .7 Flashing membrane shall be applied in weatherboard fashion starting at bottom of base of wall and working up, in and around the full perimeter of openings, to provide watertight protection and according to the following procedures:
 - .1 Apply the first strip horizontally immediately below the sill, cut it sufficiently long to extend past each side of the window, so that it projects even with the vertical jamb flashing to be applied later. Turn sill flashing up 50 mm (2") at ends of sill.
 - .2 Sill flashing shall overlap wall membrane. Overlap jamb at head flashing membrane in the same manner.

3.2 Roof Flashing Installation

- .1 Install sheet metal work in accordance with applicable NRCA Roofing Manual: Membrane Roof Systems 2011, details and as indicated.
- .2 Install sheet metal work in accordance with SMACNA Architectural Sheet Metal Manual - Seventh Edition - 2012.
- .3 *Provide* minimum 10% slope for drainage towards roof at parapet locations, with minimum 2% sloped to drain at remaining flashing locations.
- .4 Provide continuous cleats for attachment of flashings at exterior face of wall and fasten at 150 mm (6") spacing and not less than 2 fasteners per cleat.
- .5 Provide radius (3-piece) copings for curved wall condition unless otherwise indicated.
- .6 Prefabricate corner copings in 610 mm (24") x 610 mm (24") shop fabricated and connected one pieces sections.
- .7 Concealed fastenings and cleats, from view except where exposed flashings are accepted by *Consultant* prior to installation.
 - .1 Roof side fastening of copings shall be accomplished using either cleats or exposed colour matched screws with EDPM backed metal washers fastened through oversized holes in coping to allow for thermally induced movement and spaced at maximum spacing of 610 mm (24") centre to centre and not less than 2 fasteners per section of coping.
- .8 Flash joints using S-lock forming tight fit over hook strips/cleats; unless otherwise indicated.
- .9 Install surface mounted flared joint true and level, and caulk top of reglet with sealant at reglets.
- .10 Insert metal flashings to other materials and flashings to form weather-tight junction.
- .11 *Provide* prefinished metal flashing over equipment curbs which are covered with roofing membrane.
- .12 Expansion provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3048 mm (10 ft) and provide uniform joint spacing with no joints allowed within 610 mm (24") of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 25.4 mm (1") deep, filled with butyl sealant concealed within joints.
- .13 Install flexible flashing membrane in accordance with manufacturer's written installation requirements.

Metal Flashing

3.3 Wall Flashing Installation

- .1 General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.4 Roof Drainage System Installation

- .1 General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- .2 Splash pans: Install precast concrete pads set onto rigid extruded polystyrene pads where downspouts discharge on low slope roofing.
- .3 Scuppers for parapets: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and tie into roofing membrane.

3.5 Installation of Roof Accessories

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

3.6 Installation Tolerances

- .1 Shim and align sheet metal flashing and trim within installed tolerance of 6 mm in 6 m (1/4 inch in 20 feet) on slope and location lines as indicated and within 3.2 mm (1/8") offset of adjoining faces and of alignment of matching profiles.
- .2 Shim and align sheet metal flashing and trim within installed tolerances specified in Metal Construction Association (MCA) "Guide Specification for Residential Metal Roofing."

3.7 Field Quality Control

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

3.8 Adjusting and Cleaning

- .1 Remove deposits, stains or protections and wash metals left unpainted and exposed to view as recommended by manufacturer of metal or paint finish.
- .2 Clean exposed copper surfaces, removing substances that might cause discoloration of metal.

3.9 Protection

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

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Roof accessories.

1.2 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

1.3 Delivery, Storage, and Handling

- .1 Package and brace *Products* to prevent damage in shipment and handling. Protect finish surfaces by sturdy wrappings, or covering.

1.4 Extended Warranty

- .1 Warrant work of this section for a period of 2 years.

PART 2 - PRODUCTS

2.1 Walkway Materials

- .1 Provide pavers walkways as indicated on drawings.
- .2 Pavers: 610 x 610 mm size, 50 mm thick, precast concrete paver units; diamond pattern; colour as selected by Consultant.
- .3 Paver Pedestals: site fabricated, approximately 460 x 460 mm size rigid extruded polystyrene pads, 50 mm thick; having a minimum compressive strength of 210 KPA.

PART 3 - EXECUTION

3.1 Installation

- .1 Install work to meet requirements of manufacturer's written installation requirements.
- .2 Supply handling instructions, anchorage information, roughing-in dimensions, and templates for installation of work of this section, and assist or supervise, or both, setting of anchorage devices and construction of work of other sections incorporated with roof accessories.

3.2 Adjusting and Cleaning

- .1 Remove installer's equipment and debris as work progresses, and at completion of the work of this section.
- .2 Remove markings from finished surfaces.
- .3 Repair or replace defaced or disfigured finishes caused as a result of the work of this section.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Materials installed in joints to restrict the spread of fire and smoke.
 - .1 Joints in or between fire-resistance-rated constructions.
 - .2 Perimeter fire barrier systems between fire-rated floor/roof and non-rated exterior wall assembly.
 - .1 Coordinate perimeter fire barrier system installation requirements with work of curtain wall assemblies.
 - .2 Section excludes:
 - .1 Firestopping and smoke seals, for mechanical, electrical and communications penetrations of fire resistant assemblies, and firestopping and smoke seals within their respective assemblies. Refer to Divisions 21, 22, and 23 and Divisions 26, 27, and 28.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate with other sections to assure that pipes, conduit, cable, and other items that penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.
 - .2 Schedule the *Work* to assure that penetrations and other construction that conceals penetrations are not erected prior to the installation of firestop and smoke seals.
- .2 Conduct a pre-installation meeting.
 - .1 Representatives for mechanical and electrical work and independent inspection and testing company shall attend pre-installation meeting.

1.3 Submittals

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

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

1.4 Quality Assurance

 - .1 Qualifications:
 - .1 *Provide* work of this section, executed by installers with experience in application of *Products*, systems and assemblies specified and with approval, training and certification of *Product* manufacturers.
 - .1 Submit proof of manufacturer's installer certification for each installer of firestopping and smoke sealant systems.
 - .1 Manufacturer's willingness to sell its firestopping *Products* to the *Contractor* or to an installer engaged by the *Contractor* does not in itself confer qualification on the buyer.
 - .2 Applicator shall designate a single individual as *Project* foreperson who shall be present at the *Place of the Work* at all times throughout the work of this section when the work of this section is being performed.

- .3 Aspects of the work of this section are required to be prepared by a professional engineer.

1.5 Delivery Storage, and Handling

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

1.6 Field Conditions

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

PART 2- PRODUCTS

2.1 Manufacturers

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

2.2 Performance/Design Requirements

- .1 Firestop and smoke sealant systems shall consist of material, or combination of materials installed to retain integrity of fire-rated construction by effectively impeding spread of flame, smoke, and/or hot gasses through perimeter joint or gaps, construction joints, or at perimeter fire containment in or adjacent to fire-rated barriers.
- .2 Smoke sealants applied over firestopping materials or combination smoke seal/firestop seal material shall form air tight barriers to prevent passage of gas and smoke.
- .3 Fire-resistance rating of firestopping system shall be equivalent to rating of adjacent floor, wall or other fire separation assembly.
- .4 Firestopping system at fire rated assemblies with assembly STC rating requirements, shall provide STC rating equal to STC rating of fire rated assembly.
- .5 Confirm locations of exposed/non-exposed firestopping/smoke seal surfaces with *Consultant* prior to application.
- .6 *Provide* movement capability at movement joints in accordance with design requirements for movement joint.
- .7 Head-of-wall joints; with dynamic designation:

- .1 Joint assemblies to allow for vertical movement, allowing wall to move independent of structure, due to forces such as live loads, dead loads, thermal expansion/contraction, wind sway, without damaging the wall assembly or its fire protection components.
 - .1 Provide head-of-wall joints with dynamic designation.
- .8 Regulatory requirements:
 - .1 Joint firestop systems shall be listed in accordance with CAN/ULC-S115-11 and shall achieve required fire resistance rating in accordance with building code.
 - .2 Proposed firestopping and smoke seal materials and methods shall conform to applicable governing codes having local jurisdiction.

2.3 Materials

- .1 Single source responsibility for firestopping and smoke seal materials:
 - .1 Obtain firestopping and smoke seal materials from single manufacturer for each different *Product* required.
 - .2 Manufacturer shall instruct applicator in procedures for each material.
- .2 Firestopping and smoke seal systems shall conform to the following:
 - .1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gasses in compliance with requirements of CAN/ULC-S115-11 and not to exceed opening sizes for which they are intended.
 - .2 *Provide* firestopping materials and systems with fire-resistance rating not less than the fire-resistance rating of applicable adjacent assembly.
 - .3 Listed in accordance with CAN/ULC-S115-11.
 - .4 Use only joint firestop systems that have been tested by an accredited third party testing agency for specific fire-rated construction conditions conforming to construction assembly type, joint type and fire-rating requirements for each separate instance.
 - .1 Where there is no specific third party tested and classified firestop system for a particular firestop configuration, submit engineered shop drawings.
 - .5 For joints in fire-separations, provide listed systems designs for the joint firestop and smoke seal systems as required by building code to maintain the integrity of the fire separations.
 - .6 *Products* shall be compatible with abutting dissimilar membranes, architectural coatings, finishes at floors, walls and ceilings. Check with requirements of *Contract Documents* and manufacturer of selected materials being installed.
- .3 Smoke sealants for overhead and vertical joints shall be non-sagging; sealants for floors shall be self-levelling.

PART 3A. - EXECUTION

3.1 Preparation

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

3.2 Installation

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

3.3 Identification and Documentation

- .1 Provide documentation for each joint firestop system application addressed. This documentation is to identify each joint location on the entire Project.
- .2 Documentation for installed joint firestop systems is to include:
 - .1 Sequential location number.
 - .2 Project name.
 - .3 Date of installation.
 - .4 Detailed description of joint firestop system location.
 - .5 Listed firestop system design number or engineered judgment number.
 - .6 Type of joint.
 - .7 Width of joint.
 - .8 Overall length of joint.
 - .9 Number of sides addressed.
 - .10 Hourly rating of firestop joint system to be achieved.
 - .11 Installers name.

3.4 Field Quality Control

- .1 Conduct quality control.
 - .1 Field tests and inspections:
 - .1 Examine completed firestop joint installations to ensure proper installation before concealing or enclosing areas. Keep areas of work accessible until inspections are completed.
 - .2 Inspection consultant to review installation of the work of this section and to perform random tests to verify its completion in accordance with the requirements of the *Contract Documents*.
 - .3 Give at least 48 hours notice before operations commence, and arrange for a pre-job conference with *Contractor*, installer, independent inspection and testing company, manufacturer, and *Consultant* present.

- .4 Independent inspection and testing company shall examine installed firestopping in accordance with ASTM E2393-20. Independent inspection and testing company shall examine firestopping and shall determine, in general, that firestopping has been installed in accordance with requirements of the *Contract Documents* and in compliance with each listed firestop system design.
- .5 Representatives of the manufacturer(s) shall have access to the *Work*. *Contractor* shall provide assistance and facilities for such access in order that the manufacturer(s) representative(s) may properly perform its function.

END OF SECTION

Joint Sealants

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Exterior building sealants.
 - .2 Interior building sealants.
- .2 Section excludes:
 - .1 Tiling control joint sealants.
 - .2 Glazing sealants.
 - .3 Mechanical and electrical sealant work.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate cleaning, priming and installation to avoid contamination of wet, freshly coated or adjacent finished surfaces.
- .2 Conduct a pre-installation meeting.
 - .1 The following items shall be addressed at the pre-installation meeting:
 - .1 Analysis of the work and weather conditions.
 - .2 Shape factor of the joint.
 - .3 Recommendations for priming joints.
 - .4 Inspection of surfaces and joints.
 - .5 Compatibility of materials.
 - .6 Backing materials.

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
 - .2 Submit manufacturer's and *Product* name for each sealant which will be used in the *Work* prior to commencing the *Work*.
 - .3 For *Products* specified to comply with SWR Institute Sealant Validation Program, provide written confirmation from SWRI of *Product* compliance.
- .2 Samples:
 - .1 Submit "wet sample" sealant colour samples for each sealant *Product* and colour.
- .3 Test and evaluation reports:
 - .1 Test sealant in contact with samples of materials to be sealed to verify adhesion will be achieved in accordance with Field Quality Control paragraphs in this section, and no staining of the material will result. Prepare sample joints at the *Place of the Work* of each type of sealant for each joint condition.

Joint Sealants

- .1 Submit test results to *Consultant* prior to application of sealants.
- .2 Test sealant in contact with samples of porous materials to be sealed to ensure that no staining of the material will result in accordance with ASTM C1248-18.
 - .1 Submit test results to *Consultant* prior to application of sealants.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators: Installer to comply with quality assurance articles referenced in ASTM C1193-16 for installation of joint sealants.
- .2 Mock-up:
 - .1 Submit 2440 mm (96") long sealant joint mock-up.

1.5 Field Conditions

- .1 Conform to sealant manufacturer's specifications and recommendations.
- .2 Verify substrates and ambient air temperature at the *Place of the Work* before, during and after application.
- .3 Weather conditions: Do not apply silicone joint sealants in snow, rain, fog or mist, or when such conditions are expected.

1.6 Extended Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36 for a period of 2 years.
- .2 Repair or replace joint sealants which fail to perform as air tight and water-tight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, or general durability; or appear to deteriorate or become unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship or in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated.
 - .1 Defects shall include, but are not limited to:
 - .1 Staining from abutting materials or filler.
 - .2 Migrating, bleeding into, or staining abutting materials.
 - .3 Unsightly surface deformation.
 - .4 Excessive colour change, chalking, or dust pick-up.
 - .5 Failing adhesively or cohesively where maximum elongation is less than 25% of designed width of exposed joints.
 - .6 Hardening to more than 25% over specified hardness.

PART 2- PRODUCTS

2.1 Sealants

- .1 General:
 - .1 Colours: Sealant colours shall match colours of adjacent materials, as selected and approved by *Consultant*.

Joint Sealants

- .1 Colours shall be selected from manufacturer's full range of colours.
 - .2 Comply with ASTM C920-14 and other requirements indicated for each liquid-applied chemically curing sealant, including those referencing ASTM C920-14 classifications for type, grade, class, and uses.
 - .3 For sealants to be applied to porous substrates: Provide products that have undergone testing according to ASTM C1248-18 and have not stained porous joint substrates indicated for *Work*.
 - .4 Sealant supplied shall not exude any material(s) which travels into adjacent materials, or travels onto surfaces of adjacent materials; causing damage, or attracting soiling, which becomes apparent during the service life of the building.
- .2 Exterior sealants; joints in vertical surfaces:
- .1 Sealant: single-component, non-sag, low to medium modulus non-bleed, high-performance silicone joint sealant, in accordance with the following:
 - .1 Comply with:
 - .1 ASTM C920-14, Type S, Grade NS, Class 50 or greater.
 - .2 CAN/CGSB 19.13-M87.
 - .3 SWR Institute Sealant Validation Program.
 - .2 Acceptable *Products*:
 - .1 DOWSIL '790'.
 - .2 DOWSIL '795'.
 - .3 Momentive 'SCS2700 Silpruf LM or SCS 2000 Silpruf'.
 - .4 Sika 'Sikasil WS-290'.
 - .5 Sika 'Sikasil WS-295'.
 - .6 Tremco, Inc. 'Spectrem 1'.
- .3 Interior general sealants:
- .1 VOC limit: less than 250 g/L.
 - .2 Interior sealant; at joints with painted gypsum board: one-component paintable acrylic or polyurethane sealant in accordance with the following:
 - .1 Comply with:
 - .1 ASTM C834-10.
 - .2 CGSB 19-GP-5M-1984.
 - .2 Acceptable *Products*:
 - .1 Sika 'Sikaflex 1A'.
 - .2 Tremco, Inc. 'Tremflex 834'.
 - .3 Interior sealant; at movement paintable joints in vertical surfaces, no detectible odour: one-component polyurethane sealant in accordance with the following:
 - .1 Comply with:
 - .1 ASTM C920-14, Type M or S, Grade NS, Class 25.

Joint Sealants

- .2 CAN/CGSB 19.13-M87.
- .2 Acceptable *Products*:
 - .1 Master Builders Solutions Canada 'MasterSeal NP100'.
 - .2 Sika 'Sikaflex 15LM'.
- .4 Interior sealant; at movement joints in vertical surfaces: one-component polyurethane sealant in accordance with the following:
 - .1 Comply with:
 - .1 ASTM C920-14, Type M or S, Grade NS, Class 25.
 - .2 CAN/CGSB 19.13-M87.
 - .2 Acceptable *Products*:
 - .1 Master Builders Solutions Canada 'MasterSeal NP1'.
 - .2 Sika 'Sikaflex 15LM'.
 - .3 Tremco, Inc. 'Dymonic 100'.

2.2 Accessories

- .1 General: *Provide* joint sealants, primers, backings, and fillers that are compatible with one another and with joint substrates and other sealants or joint fillers specified and approved for applications indicated under joint sealant scheduled and under conditions of service and application as demonstrated by joint sealant manufacturer based on proven test results and field experience. When incompatible, inform *Consultant* and change to compatible type acceptable to *Consultant*.
- .2 Cylindrical sealant backings: *Provide* joint backings that meet ASTM C1330-02, Type O (open-cell polyurethane), or Type B (non-absorbent bi-cellular backing materials with surface skin), sized 25 percent or greater than joint opening with proper density to control sealant depth and profile. Follow joint sealant manufacturer's recommendations with backing selections for optimum joint sealant performance, in accordance with the following schedule:
 - .1 Use open cell foam with non-absorbing closed cell skin (Sof-Rod) for vertical joints; round shape for open joints and triangular shape for angular joints.
 - .2 Use closed cell foam for horizontal joints.
- .3 Bond-breaker tape: Polyethylene tape or other approved plastic tape as recommended by joint sealant manufacturer to prevent 3-sided joint adhesion to rigid, inflexible joint fillers or joint surfaces at back of joint where such adhesion would restrict proper sealant movement or result in sealant failure.
- .4 Masking tape: Non-staining, non-absorbent and compatible with joint sealants and adjacent surfaces.
- .5 Sealant primers: Use primers only as recommended by sealant manufacturer where required to enhance adhesion of sealant to specific joint substrates indicated and as determined for use from pre-construction mock-up testing. Select primers in consultation with sealant manufacturer and manufacturer of substrate material which do not have a detrimental effect on sealant adhesion or in-service performance.
- .6 Cleaners for nonporous surfaces:

Joint Sealants

- .1 Provide non-staining, chemical cleaners of type which are acceptable to manufacturer of sealant and sealant backing material, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.
- .2 Provide cleaner conditioner required for glass and glazed surfaces as recommended by sealant manufacturer.

PART 3 - EXECUTION

3.1 Manufacturer's Recommendations

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

3.2 Preparation

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

3.3 Masking

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

3.4 Installation

- .1 Apply joint sealants for continuous waterproof sealant joint protection. Vertical joints shall be lapped over horizontal joints as recommended by sealant manufacturer. Comply with installation recommendations in ASTM C1193-16 for use of joint sealants as applicable to each specific sealant installation.
- .2 Install sealant primers only when recommended by sealant manufacturer and demonstrated at pre-construction tests after joint surface preparation has been completed and when surfaces are verified as clean and dry. Allow any primer installation to completely dry or cure prior to installation of backing or joint sealants. Primer is mandatory for gun applied sealants.
- .3 Install joint sealants using proven techniques that comply with the following and in proper sequence with installation of primers and backings.

Joint Sealants

- .1 Using proper joint sealant dispensing equipment, place sealants by pushing sealant beads into opening to fully wet-out joint sealant substrates. Fill sealant joint opening to full and proper configuration.
- .2 Install, providing uniform cross-sectional shapes and depths in relation to joint width for optimum sealant movement capability per joint sealant manufacturer's written requirements.
- .4 Joint sealant tooling is required for non-sag joint sealant installations. Immediately after placing fresh sealants and before skinning or curing begins, tool sealants using metal spatulas designed for this purpose in accordance with manufacturer's recommendations. Provide a smooth, uniform sealant finish, eliminating air pockets and ensuring good contact for optimum sealant adhesion within each side of the joint opening.
 - .1 Provide concave joint configuration as indicated per figure 5-A in ASTM C1193-16 unless otherwise indicated.
 - .2 Use tooling agents that are approved in writing by sealant manufacturer and that do not discolour sealants or adjacent surfaces.
 - .3 Remove excess sealant from surfaces adjacent to joint openings using metal spatula, promptly cleaning any sealant residue from adjacent finished surfaces. Remove masking after joint sealant is installed.
- .5 Allow single-component sealants to fully cure before adhesion testing is performed as recommended by joint sealant manufacturer.
- .6 Match approved sealant mock-up for colour, finish and overall aesthetics. Remove, refinish or re-install work not in compliance with the *Contract Documents*.
- .7 When surfaces of adjacent materials are to be painted, perform sealant work before these surfaces are painted.
- .8 Check form release agent used on concrete for compatibility with primer and sealant. If they are incompatible inform *Consultant* and change primer and sealant to compatible type, or clean concrete to sealant manufacturer's acceptance.
- .9 Install joint backing material, filler strips, gaskets, bond breakers and similar type material of comparable performance characteristics. Install bond breaker tape or packing over asphalt impregnated fibre board as recommended by sealant manufacturer.
- .10 Where joints are 12.7 mm (1/2") or deeper, insert backing material in continuous uniform compression with setback from finished face of adjoining materials equal to required depth of sealant (width/depth ratio) as specified herein.
- .11 On horizontal traffic surfaces, support joint filler against vertical movement which might result from traffic loads, including foot traffic.
- .12 Install bond breaker tape in bottom of joints in lieu of sealant backing where proper depth cannot be obtained when backing is installed.
- .13 Maintain correct sealant depth. Sealant depth shall be 1/2 the width of the joint, maximum depth shall be 12.7 mm (1/2"), minimum depth shall be 6 mm (1/4"). Comply with manufacturer's written recommendations.
- .14 Fillet bead sealant joints to be sized to provide proper contact area with substrates, in accordance with manufacturer's written recommendations.
- .15 Apply sealants using pressure-operated guns fitted with suitable nozzles in accordance with manufacturer's directions. Apply sealants in such manner as to ensure good adhesion to sides of joints and to completely fill voids in joints.

Joint Sealants

- .16 Apply sealants so that surfaces of joints are smooth, full bead, free from ridges, wrinkles, sags, air pockets and embedded impurities. Tool sealant surfaces to produce a smooth surface.
- .17 Install sealant with exterior face of sealant set back 10 mm (3/8") from face of adjacent materials at building movement joints, unless otherwise indicated.
- .18 Do not apply sealants to areas where installation of paints, coatings or flooring is in progress. Apply sealants after such work is complete and fully cured.

3.5 Exterior Sealant Schedule

- .1 Include in work of this section joint sealants in exterior assemblies to seal open joints in surfaces exposed to view, and to make building weather-tight, as indicated, and as otherwise specified, except where specified under the work of other sections.
- .2 Exterior sealant work is part of the work of this section. Install sealant to:
 - .1 Perimeters of exterior openings where frames/glazing meet exterior facade of building.
 - .2 Movement and control joints in exterior surfaces of insitu concrete and masonry.
 - .3 Exterior joints between masonry and insitu concrete.
 - .4 Exterior joints in horizontal wearing surfaces.

3.6 Interior Sealant Schedule

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

3.7 Adjusting and Cleaning

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

3.8 Protection

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

Joint Sealants

END OF SECTION

Steel Doors and Frames

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Hollow metal doors and panels (steel doors).
 - .2 Metal frames (steel frames for screens, sidelights, window assemblies).

1.2 Administrative Requirements

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

1.3 Submittals

- .1 Submit copy of NAAMM-HMMA 840-17 standard.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Include details of each door and frame type, finish hardware types and locations, frame profiles, door and frame elevations, mitre details, glazing preparation details and anchor details and locations.
 - .2 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.
 - .3 Electrified hardware requirements and preparations shall be clearly indicated on shop drawings.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 *Provide* doors and frames manufactured by a firm specializing in the design and production of hollow metal steel doors and frames.

1.5 Delivery, Storage, and Handling

- .1 Inspect materials thoroughly upon receipt and report immediately discrepancies, deficiencies and damages, in writing, to *Supplier*.
- .2 Note damages incurred during shipment on carriers' bill of lading and report immediately, in writing, to *Supplier*.
- .3 Store materials properly on planks, out of water and covered to protect from damage from adverse weather conditions. Remove wet packaging immediately.

Steel Doors and Frames

- .4 Remove wrappings or coverings from doors upon receipt at the *Place of the Work*, and store in a vertical position, spaced with blocking to permit air circulation between them.

1.6 Extended Warranty

- .1 Warrant work of this section for a period of 2 years.
- .2 Repair or replace steel doors and frames that fail within the specified warranty period.
- .3 Failures shall include but not be limited to out of true alignment, failure to operate and swing freely, smoothly, and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force. The warranty includes re-installation of hardware, re-hanging and fitting.

PART 2 - PRODUCTS

2.1 Door and frame products

- .1 Doors and frames supplied by Owner.
 - .1 Provide glazing and hardware to suit doors and frame provided.
 - .2 Refer to door schedule.

2.2 Materials

- .1 Steel:
 - .1 Fabricated from tensioned levelled steel to ASTM A924/A924M-18, galvanized to ASTM A653/A653M-13, Commercial Steel CS, Type B.
 - .2 Steel shall be free of scale, pitting, coil breaks, surface blemishes, buckles, waves, and other defects.
 - .3 Minimum sheet thickness; uncoated steel sheet: in accordance with Appendix 1 of ANSI/NAAMM HMMA 861-14 "Guide Specifications for Commercial Hollow Metal Doors and Frames".
 - .4 Finish: Minimum Galvanneal coating designation ZF120 (A40).
- .2 Adhesives:
 - .1 Heat resistant, single component, polyurethane reactive (water) hot melt, thermoset adhesive.
 - .2 Lock seam doors: resin reinforced polychloroprene, high viscosity sealant-adhesive.
- .3 Primer: rust inhibitive for touch-up.
- .4 Finishing hardware: in accordance with Section 08 71 00.
- .5 Miscellaneous:
 - .1 Door silencers: single stud rubber or neoprene type.
 - .2 Channel glazing stops and glazing trim: formed channel of minimum 0.81 mm (0.032") (20 gauge) steel, 15.9 mm (5/8") high.

2.3 Fabrication - General

- .1 Fabricate steel doors, frames, transoms, sidelights and borrowed lights as applicable, to the design and dimensions indicated. Take field measurements where coordination with adjoining work is necessary.

Steel Doors and Frames

- .2 Fabricate steel doors and frames to be rigid, neat in appearance and free from defects, warp, wave or buckle with all corners square unless otherwise indicated.
- .3 Operating clearances:
 - .1 *Provide* clearance at floor with allowance made for indicated finish flooring materials.
 - .2 Clearances: Not more than 3 mm (1/8") at jambs and heads, except not more than 6 mm (1/4") between pairs of doors. Not more than 19 mm (3/4") at bottom.
- .4 Drill and tap or reinforce for mortised or surface mounted hardware in accordance with accepted hardware schedule, ANSI A115, NFPA 80-2013, or manufacturers recommendations.
- .5 Countersink exposed fasteners unless otherwise shown. Use flat or oval head screws.
- .6 Reinforce components to resist stresses imposed by hardware in use.
- .7 Allow for anticipated expansion and contraction of frames and supports.
- .8 Fit elements at intersections and joints accurately together, in true planes, and plumb and level.
- .9 Perform welding to CSA W59-13.
- .10 Mortise, reinforce, drill and tap to receive hardware and security devices using templates provided by respective *Supplier*.
- .11 Touch up finish damaged during fabrication.
- .12 Prepare doors or frames to receive seals where seals are indicated.

2.4 Fabrication - Steel Doors and Panels

- .1 Fabricate steel doors and panels to a thickness of 45 mm (1-3/4"), unless indicated otherwise.
- .2 Interior and non-insulated doors and panels:
 - .1 Face sheets fabricated from 1.06 mm (0.042") (18 gauge) steel.
 - .2 Honeycomb core.
 - .3 Longitudinal edges mechanically interlocked.
 - .1 Adhesive assisted with edge seams visible.
 - .4 Top and bottom of clean room doors shall be provided with 16 gauge continuous flush steel non-removable door cap welded securely in place to achieve a flat smooth transition.
- .3 Fabricate of composite metal face construction with each face formed from flush sheet steel without visible seams, free of scale, pitting, coil brakes, buckles and waves.
- .4 Formed edges shall be true and straight with minimum radius for the thickness of steel used.
- .5 Lock and hinge edges shall be bevelled 3 mm in 50 mm (1/8" in 2") unless hardware or door swing dictates otherwise.
- .6 Top and bottom of doors shall be provided with inverted, recessed, 1.34 mm (0.053") (16 gauge) steel end channels, welded to each face sheet at 50 mm (2") on centre maximum.
- .7 Prior to shipment, mark each door with an identification number as shown on the approved submittal drawings.
- .8 Blank, reinforce, drill and tap doors for mortised, templated hardware. Locate hardware to manufacturer's standard unless indicated otherwise.
- .9 Holes 12.7 mm (1/2") and larger shall be factory prepared.

Steel Doors and Frames

.10 Glazing:

- .1 For glazing materials up to and including 8 mm (5/16") thick, doors shall be provided with 0.81 mm (0.032") (20 gauge) steel glazing trim and snap-in glazing stops.
- .2 For glazing materials greater than 8 mm (5/16") thick, doors shall receive 0.81 mm (0.032") (20 gauge) steel trim and screw fixed glazing stops. Screws shall be #6 x 32 mm (1-1/4") oval head Tek™ (self-drilling) type at 305 mm (12") on centre maximum.
- .3 Glazing trim and stops shall be accurately fitted (within 0.39 mm (0.015") tolerance), butted at corners, with removable glazing stops located on the 'push' side of the door.

2.5 Fabrication - Steel Frames

- .1 General: Applicable to frames, transom panel frames, sidelights, and window assemblies.
- .2 Interior and non-thermally broken frames; welded:
 - .1 Fabricated from:
 - .1 1.34 mm (0.053") (16 gauge) steel.
 - .2 Supplied set-up and welded (SUW).
 - .3 Factory assembled frame product shall be square, free of defects, warps or buckles.
 - .4 Set-up and welded corner joints (SUW):
 - .1 Profile welded—punch mitred, continuously welded on inside of the profile faces, rabbets, returns and soffit intersections, with exposed faces filled and ground to a smooth, uniform seamless surface, as defined in the CSDMA - "Recommended Specifications for Commercial Steel Door and Frame Products".
 - .5 Set-up and welded joints at mullions, sills and center rails:
 - .1 Coped accurately, butted and tightly fitted.
 - .2 At intersecting flush profile faces, securely weld, fill and grind to flush, smooth, uniform, seamless surface.
 - .3 At intersecting recessed profile faces, securely weld to concealed reinforcements, with exposed hairline face seams.
 - .4 At other intersecting profile elements make exposed face seams to hairline tolerance.
 - .6 Where required due to site access, when required for co-ordination or installation, or shipping limitations, frame product shall be fabricated in sections for splicing in the field.
 - .1 Field spliced jambs, heads and sills shall be provided with 1.34 mm (0.053") (16 gauge) steel splice plates securely welded into one section, extending 100 mm (4") minimum each side of splice joint.
 - .2 Field splices at closed sections (mullions or center rails) shall be 1.34 mm (0.053") (16 gauge) steel splice angles securely welded to the abutting member. Face of splice angle shall extend 100 mm (4") minimum into closed sections when assembled.
 - .3 Field splice joints shall be welded, filled and ground to present a smooth uniform surface by the installation company responsible for installation after assembly.
 - .7 On factory assembled frame product, provide 2 temporary steel shipping bars welded to the base of the jambs or mullions to maintain alignment during shipping and handling. Remove shipping bars prior to anchoring of frames to floor.

Steel Doors and Frames

- .8 Each door opening shall be prepared for single stud door silencers. Silencers shall be shipped loose for installation by installer, after finish painting.
 - .1 Single interior doors: 3 at strike jamb.
- .9 Prior to shipment, mark each frame with an identification number as shown on the approved submittal drawings.
- .10 Provide mullions and transom bars of closed construction type. For fixed condition, attach members to frame with butt-welded joints. For removable condition, attach members with removable mullion anchors.
- .11 Conceal fastenings unless otherwise indicated.
- .12 Anchor frames to floor by 1.34 mm (0.053") (16 gauge) thick angle clips, welded to frame and *Provide* with 2 holes for floor anchorage.
- .13 Grind welded corners to a flat plane, fill with metallic paste filler and sand to uniform smooth finish.
- .14 Protect strike and hinge reinforcements using guard boxes welded to frames at masonry construction.
- .15 Reinforce head of frames wider than 1220 mm (48").
- .16 Brace frame units to prevent distortion in shipment and protect finish.

2.6 Hardware Reinforcements and Preparations

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

Steel Doors and Frames

- .11 Provide hardware mortises on perimeter frame members to be grouted in masonry or concrete partitions with 0.66 mm (0.026") (22 gauge) steel grout guards.
- .12 Electrified hardware:
 - .1 Where electrified hardware is scheduled, steel door and frame product shall be provided with ElectroLynx™ System or approved alternative consisting of CSA approved conduit, junction boxes and fifteen (15) wire harnesses complete with modular plugs for coordinated connection directly to electrified hardware. Refer to Section 08 71 00 – Door Hardware and Division 26 for openings that require electrified hardware.

2.7 Frame Anchorage

- .1 Frame products shall be provided with anchorage appropriate to floor, wall and frame construction.
- .2 Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb.
- .3 Frame products for installation in new masonry walls shall be provided with steel adjustable wall anchors of the T-strap, stirrup or wire, 1.34 mm (0.053") (16 gauge) minimum or 3.96 mm (0.156") diameter wire. Straps shall be not less than 50 mm (2") x 254 mm (10") in size, corrugated and/or perforated.
- .4 Frame products installed in steel stud and drywall partitions shall be provided with 0.81 mm (0.032") (20 gauge) steel snap-in or "Z" stud type anchors.
- .5 Jambs of frames in previously placed concrete, masonry or structural steel shall be punched and dimpled to accept machine bolt anchors, 6.4 mm (1/4") diameter, located not more than 150 mm (6") from the top and bottom of each jamb. Anchor preparations and guides shall also be located immediately above or below the intermediate hinge reinforcing and directly opposite on the strike jamb. Each preparation shall be provided with 1.34 mm (0.053") (16 gauge) anchor bolt guides.
- .6 Anchor bolts and expansion shell anchors for the above preparations shall be provided by the installation company.
- .7 Where frame product is installed prior to construction of the adjacent wall, each jamb shall be provided with 1.34 mm (0.053") (16 gauge) steel floor anchors. Each anchor shall be provided with 2 holes for mounting to the floor and shall be securely welded to the inside of the jamb profile.
- .8 On sidelights or windows exceeding 3 m (9'-10") in width, installed in stud partitions, channel extensions shall be provided from the top of the frame assembly to the underside of the structure above. Extensions shall be fabricated from 2.36 mm (0.093") (12 gauge) steel formed channels, mounting angles and adjusting brackets, with mounting angles welded to the inside of frame head. Formed channels, adjusting brackets and fasteners shall be shipped loose. Channels shall be mechanically connected to mounting angles and adjusting brackets with supplied fasteners, on site, by contractor responsible for installation.

2.8 Sizes and Tolerances

- .1 Widths of door openings shall be measured from inside of frame jamb rabbet with a tolerance of ± 1.6 mm (± 0.063 ").
- .2 Heights of door openings shall be measured from the finished floor (exclusive of floor coverings) to the head rabbet of the frame with a tolerance of ± 1.2 mm (± 0.047 ").
- .3 Unless finishing hardware dictates otherwise, doors shall be sized so as to fit the above openings and allow a 3 mm (1/8") clearance at jambs and head. A clearance of 19 mm (3/4") between the bottom of the door and the finished floor (exclusive of floor coverings) shall be provided. Tolerances on door sizes shall be ± 1.2 mm (± 0.047 ").

Steel Doors and Frames

- .4 Manufacturing tolerances on formed frame profiles shall be ± 0.8 mm (± 0.031 "") for faces, door stop heights and jamb depths. Tolerances for throat openings and door rabbets shall be ± 1.6 mm (± 0.063 "") and ± 0.4 mm (± 0.016 "") respectively. Hardware cut-out dimensions shall be as per template dimensions, ± 0.4 mm ($+0.015$ "").

2.9 Hardware Locations

- .1 Hardware preparations in frame product shall be as noted below and locations on doors shall be adjusted for clearances specified in paragraph 2.9 of this section.
- .2 Install door hinges spaced in accordance with spacing indicated.
- .3 Strike preparations for unit, integral, cylindrical and mortise locks and roller latches shall be centered 1033 mm (40-5/16") from finished floor. Strikes for deadlocks shall be centered at 1220 mm (48") from finished floor. Strikes for panic or fire exit hardware shall be located as per device manufacturer's templates.
- .4 Push and/or pulls on doors shall be centered 1070 mm (42") from finished floor.
- .5 Preparations not noted above shall be as per hardware manufacturer's templates.
- .6 Hardware preparation tolerances shall comply with the ANSI A115 standards.

PART 3 - EXECUTION

3.1 Examination

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

3.2 Installation - Steel Doors and Frames

- .1 Set frame product plumb, square, aligned, without twist at correct elevation in accordance with NAAMM-HMMA 840-17.
- .2 Frame product installation tolerances:
 - .1 Plumbness tolerance, measured through a line from the intersecting corner of vertical members and the head to the floor, shall be ± 1.6 mm ($\pm 1/16$ "").
 - .2 Squareness tolerance, measured through a line 90° from one jamb at the upper corner of the product, to the opposite jamb, shall be ± 1.6 mm ($\pm 1/16$ "").
 - .3 Alignment tolerance, measured on jambs, through a horizontal line parallel to the plane of the wall, shall be ± 1.6 mm ($\pm 1/16$ "").
 - .4 Twist tolerance, measured at face corners of jambs, on parallel lines perpendicular to the plane of the wall, shall be ± 1.6 mm ($\pm 1/16$ "").
- .3 Brace frame product rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install temporary wood spreaders at mid-point of frame rabbet height to maintain frame widths. Remove wood spreaders after product has been built-in.
- .4 Provide vertical support at center of head for openings exceeding 1250 mm (48") in width.
- .5 Secure anchorages and connections to adjacent construction.
- .6 Execute installation and assembly using skilled forces under supervision of a competent joinery foreperson.

Steel Doors and Frames

- .7 Install doors in accordance with NAAMM-HMMA 840-17, maintaining clearances outlined in paragraph 2.10 of this section.
- .8 Adjust operable parts for correct clearances and function.
- .9 Steel surfaces shall be kept free of grout, tar or other bonding materials or sealers.
- .10 Remove grout or other bonding material from products immediately following installation.
- .11 *Provide* appropriate anchorage for floor and wall construction. Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite the strike jamb. On each jamb, install 2 anchors for openings up to and including 1525 mm (60") high and install 1 anchor for each additional height of 760 mm (30") of height or fraction thereof, except as indicated below. Frames placed in previously placed concrete, masonry or structural steel shall be *Provided* with anchors located not more than 150 mm (6") from top and bottom of each jamb, and intermediate anchors at 660 mm (26") on centre maximum.
- .12 Secure frames set in previously constructed concrete or masonry openings by countersunk expansion bolts at same centres as for adjustable Tee wall anchors. Reinforce frame at fastening location to prevent indentation of frame by fastening device.
- .13 Fill and grind smooth "punch and dimpled" frame installations.
- .14 Prior to site touch-up, exposed surfaces of galvanneal steel to be finished shall be cleaned to remove foreign matter. Refer to paint manufacturers recommendations for additional information and requirements of Section 09 91 00.
- .15 Touch-up exposed field welds shall be finished to present a smooth uniform surface and with a rust inhibitive primer.
- .16 Touch-up exposed surfaces that have been scratched or otherwise marred during shipment, installation, and handling shall be with a rust inhibitive primer.
- .17 Finish paint in accordance with Section 09 91 00.
- .18 Install door silencers.
- .19 Adequately fasten units and secure in place with concealed fixings wherever possible. Include grounds and furring where required.
- .20 Make allowance for deflection to ensure structural loads are not transmitted to frames.
- .21 Adjust operable parts for correct clearances and function.

3.3 Installation - Finishing Hardware

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

3.4 Adjusting and Cleaning

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

Steel Doors and Frames

- .4 Clean hardware after installation in accordance with *Supplier's* requirements.

END OF SECTION

Flush Wood Doors

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Salvaged and Owner provided solid core doors with wood veneer.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Cooperate with work of other sections to ensure fastenings set by others are provided and located, their work is installed to their specifications and that those responsible for back priming are notified in sufficient time for them to schedule work.
 - .2 Coordinate installation of doors with installation of frames specified in other Sections and hardware specified in Section 08 71 00.
 - .3 Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .2 Shop drawings:
 - .1 Submit shop drawings for the work of this section complying with the North American Architectural Woodwork Standards 3.1 requirements.
 - .2 Indicate door location using numbering system per door schedule, size, and hand of each door, elevation of each door type; undercuts, bevelling, construction type core and edge construction not covered in product data; and special blocking requirements.
 - .3 Indicate dimensions and locations of factory machining criteria for hardware, extent of hardware blocking.
 - .4 Indicate dimensions and locations of cut-outs including trim for openings.
 - .5 Indicate electrified hardware requirements and preparations.
- .3 Verification samples:
 - .1 Submit cut-away sample of each type of door, to show stile and rail construction, core, cross banding, door face finish and edges.

1.4 Delivery, Storage, and Handling

- .1 Door numbers shall be marked with door numbers used on shop drawings in the top hinge cavity created by the machining for hinges.
- .2 Identify doors with labels. Package with resilient packaging.
- .3 Store doors flat at the *Place of the Work* in piles with bottom face on bottom of pile. Protect from moisture by placing water resistant material under skids supporting piles. Cover top of piles and provide air at sides of piles.

Flush Wood Doors

- .4 Deliver the wood doors only after the building is closed and dry and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period. Do not receive the doors in a damp area. Do not drag the doors on the ground, floor or across one another.

1.5 Field Conditions

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

1.6 Extended Warranty

- .1 Warrant work of this section for a period of 2 years.
- .2 Repair or replace wood doors that fail or are defective within the specified warranty period. The warranty includes re-installation of hardware, re-hanging fitting, and finishing.
- .3 Failures shall include but not be limited to out of true alignment, failure to operate and swing freely, smoothly, and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.
- .4 Defects shall include, but not be limited to, delaminating, telegraphing of core construction in face veneers exceeding 0.254 mm (0.01") in a 75 mm (3") span, and warp exceeding 3 mm (1/8") in a 1066 mm (42") x 2133 mm (84") section.

PART 2- PRODUCTS

2.1 Product

- .1 Wood Doors:
 - .1 Salvaged solid core doors
 - .2 Owner provided solid core doors
- .2 Blocking:
 - .1 *Provide* hardware blocking for doors as follows:
 - .1 Non-rated doors: Structural composite lumber for hardware blocking.
- .3 Thickness:
 - .1 45 mm (1-3/4") minimum unless otherwise indicated or scheduled.

2.2 Accessories

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

Flush Wood Doors

2.3 Fabrication

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

2.4 Site Finishing

- .1 Stain: in accordance with Section 09 91 00.
- .2 Seal top and bottom door edges.

PART 3 - EXECUTION

3.1 Examination

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

3.2 Installation - General

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

3.3 Installation - Doors

- .1 Align and fit doors in frames with uniform clearances as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - .1 Clearances:
 - .1 Provide clearances as follows except where more stringent clearance is required or indicated.

Flush Wood Doors

- .2 Provide 3.18 mm (1/8") maximum clearance between door and frame at heads, jambs, and between pairs of doors.
- .3 Provide minimum 6 mm (1/4") clearance from bottom of door and top of floor finish and maximum clearance of 9.5 mm (3/8").
- .2 Seal top and bottom edges of wood doors if they are cut to fit, in accordance with door manufacturer's warranty requirements.
- .3 Pilot drill screw and bolt holes.

3.4 Installation - Finishing Hardware

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

3.5 Adjusting and Cleaning

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

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Fixed aluminum sidelight, transom, and entrance framing.
 - .2 Aluminum entrance doors.
 - .3 Foamed-in-place (gap filler) filler insulation.
 - .4 Fixed glazed aluminum windows framing.
 - .5 Operable aluminum windows.
 - .6 Glass and glazing in accordance with Section 08 80 00.
 - .7 Seal joints within the work of this section in accordance with Sections 07 92 00, except where specified otherwise and at abutting joints between this section and the work of other sections.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting with the following requirements:
 - .1 Review methods and procedures related to glazing systems including the following:
 - .1 Review flashings, special interface details and scheduling with adjacent material assemblies, penetrations, and conditions of other construction that will affect glazing systems.

1.3 Submittals

- .1 Submit warranty specimen prior to commencement of shop drawings.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Submit engineered shop drawings:
 - .1 Indicate with plans, sections, elevations and sufficient full size details, components and methods of assembly, materials and their characteristics relative to their purpose, and other fabrication information including relationships to adjacent systems.
 - .2 Identify and describe material types being supplied, wall thicknesses of extrusions, and shapes including connections and grades, dimensions and tolerances (minimum and maximum), attachments, reinforcing, anchorage and locations of fastenings, and provisions for thermal and structural movement between components of this section and adjacent materials.
- .4 Design calculations:
 - .1 Submit under seal, calculations prepared by the professional engineer responsible for the preparation of the shop drawings that clearly indicate the following:
 - .1 Design assumptions regarding loadings, related to the building code.
 - .2 Codes and standards to which calculations are based upon.
 - .3 Materials proposed and their allowable shear and bending stresses.

- .4 Maximum and minimum tolerances for proposed materials including anchors, holes and spacings.
 - .5 Testing data to confirm compliance with performance requirements for the work of this section.
 - .6 Analysis for dead, wind, snow and guard loads as required and movements caused by temperature changes, support deflections and building sway.
 - .7 Analysis to include anchors, glazing members, structural joints, sealants, glass. Show section property computations for framing members and submit full sized drawings.
- .5 Test reports:
- .1 Submit valid independent laboratory test reports of full-scale mock-up for the specific glazing systems required under the work of this section, including framing members, glazing units, anchorage, , doors and transitions to adjoining assemblies and materials to demonstrate compliance respecting specified air and water infiltration and environmental separation performance and specified performance requirements specified in this section.

1.4 Closeout Submittals

- .1 Operation and maintenance data:
 - .1 Provide training to the *Owner* in the operation, maintenance, and cleaning of the aluminum framed glazing systems. Submit printed copies of maintenance instructions given to the *Owner*.

1.5 Quality Assurance - General

- .1 Installers / applicators / erectors:
 - .1 The work of this section shall be performed by a *Subcontractor* who is regularly engaged in the engineering, manufacture, fabrication, assembly, glazing. *Subcontractor* shall demonstrate to the acceptance of the *Consultant*, that they have successfully performed on comparable projects.
- .2 Aspects of the work of this section are required to be prepared by a professional engineer.

1.6 Delivery, Storage, and Handling

- .1 Comply with AAMA CW-10-15 – Care and Handling of Architectural Aluminum from Shop to Site.
- .2 Store parts and materials in a dry place and permit natural ventilation over their finished surfaces and protected from damage by other trades.
- .3 Under conditions of high humidity or cold temperatures, supply heating or forced air ventilation to prevent accumulation of surface moisture.
- .4 Mark components to show location on building and on drawings.
- .5 Protect finishes with strippable coating that will not mar, nor deface finish on removal, or a similar method designed to afford an equivalent amount of protection. Leave protected coating intact until damage risk is past or immediately prior to final cleaning.
- .6 Stacking should be done to prevent bending pressure or abrasion of finished surfaces.

1.7 Extended Warranty

- .1 Special systems warranty: Standard form in which warrantor agrees to repair or replace components and assemblies that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

- .1 Failures include, but are not limited to, the following:
 - .1 Structural failures including, but not limited to, excessive deflection.
 - .2 Noise or vibration created by wind and thermal and structural movements.
 - .3 Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - .4 Water penetration through fixed glazing and framing areas.
 - .5 Failure of operating components.
 - .6 Failed glass units.
- .2 Warranty period: 5 years.
- .2 Special product warranty; glass units: in accordance with Section 08 80 00.

PART 2 - PRODUCTS

2.1 Manufacturer

- .1 Manufacturers shall develop materials and *Products* of this and related sections to achieve design intent as indicated and specified.
- .2 Subject to compliance with requirements, provide products by one of the following manufacturers:
 - .1 Alumicor Limited.
 - .2 Kawneer Company Canada Limited.
 - .3 Sherwood Windows.
 - .4 Aerloc Industries Ltd.

2.2 Glazing System Design - Specific Component Requirements

- .1 Glass Design:
 - .1 Glass shall be designed according to CAN/CGSB 12.20-M89 and Section 08 80 00.
 - .2 Insulating glass units in accordance with Section 08 80 00.
- .2 Aluminum entrances, screens, and framing:
 - .1 Acceptable entrance framing products; thermally broken:
 - .1 Exterior entrance framing; Basis of Design *Products*:
 - .1 Alumicor 'FlushGlaze BF 3400'.
 - .2 Kawneer 'TRIFAB 451T'.
 - .2 Acceptable door products:
 - .1 Exterior doors (wide stile); acceptable Basis of Design *Products*:
 - .1 Alumicor 'ThermaPorte 7700', wide stiles
 - .2 Kawneer '500T Insulpour Thermal Entrances'.
- .3 Description:
 - .1 Fasteners: concealed.

Aluminum Framed Glazing Systems

- .2 Door framing connections: Reinforce mechanically-joined corners of doors by welding, spigotting, welding and spigotting or by one piece cast aluminum angle to produce sturdy door unit.
- .3 Weather-stripping: Dense, bulb polymeric material, resilient and retains weathering ability under temperature extremes, complete with EPDM blade gasket sweep strip applied to the bottom door rail with concealed fasteners.
- .4 Door hardware;
 - .1 Provide 4 hinges, closer, pull, panic device and 1 threshold for each door leaf.
 - .2 Hinges:
 - .1 Acceptable products:
 - .1 McKinney TA786 Heavy Weight Hinge, Finish: 32 D Satin Stainless Steel
 - .3 Closers:
 - .1 Acceptable Product:
 - .1 LCN 4040 Heavy Duty, Metal Cover, Finish 689 Aluminum
 - .2 Provide arm and accessories to match existing configuration.
 - .4 Pulls: Kawneer CO-9 Pull or similar to.
 - .5 Panic Device
 - .1 Sargent 16-8810J, including cylinder dogging
 - .6 Thresholds: Provide aluminum mill finish threshold by aluminum framed glazing system manufacturer.

2.3 Windows

- .1 Fixed windows:
 - .1 Basis of Design *Products*:
 - .1 Alumicor 'ShadowLine 970'.
 - .2 Thermally broken sections, inside glazed.
 - .3 Fasteners: concealed in closed positions, tamperproof where exposed in open positions, austenitic stainless steel.
 - .4 Glazing pockets shall be vented, pressure equalized and drained to the exterior.
 - .5 Elastomeric air seal gasket shall be installed around the full perimeter of glass and sealed at corners with silicone sealant. Air seal gasket must provide adhesion with silicone sealant.
- .2 Operable windows:
 - .1 Basis of Design *Products*:
 - .1 Alumicor 'Univent 1350'.
 - .2 Thermally broken sections, inside glazed.
 - .3 Fasteners: concealed in closed positions, tamperproof where exposed in open positions, austenitic stainless steel.
 - .4 Glazing pockets shall be vented, pressure equalized and drained to the exterior.

Aluminum Framed Glazing Systems

- .5 Elastomeric air seal gaskets shall be installed around the full perimeter of glass and sealed at corners with silicone sealant. Air seal gasket must provide adhesion with silicone sealant.
- .6 Hardware; manual operated projected out windows:
 - .1 Material shall be corrosion resistant and compatible with aluminum. Hardware must prove its strength and suitability by being installed on units, which are tested in accordance with specifications.
 - .2 Fasteners: Provide nonmagnetic stainless steel screws, epoxy adhesives, or other material warranted by the manufacturer. Where locks, handles or operators screw anchor through aluminum, reinforce interior with stainless steel splined grommet nuts.
 - .3 *Provide* concealed controlled restriction device to limit operable windows to permit maximum opening as indicated on drawings, when device is engaged.
 - .4 Finish: Baked-on finish to match adjacent framing finish.
 - .5 Sash: corner keyed, sealed, and hydraulically staked.
 - .6 Hardware:
 - .1 Equip each operable window with 1 pair of butt hinges in accordance with manufacturer's written recommendations.
 - .2 Equip each window unit with crank operated, single lever type roto-operator.
 - .3 Equip each operable window with single lever, dual locking device.
 - .4 Hardware shall be ADA compliant.
 - .5 Screens:
 - .1 Screen frames: Extruded aluminum secured with turn-clip fasteners and colour to match exterior window frame.
 - .2 Screen: Heavy duty stainless steel screen, Phifer SeeVue Stainless Black, in extruded aluminum frame.
 - .6 Friction limiter.
 - .7 Sash limiter or Teleflex operators to be designed by installer and approved by Consultant.
 - .1 Sash limited installed for areas below guard height
 - .2 Teleflex operators installed for all remote window locations and above guard height.

2.4 Performance/Design Requirements - General

- .1 Design and size components to withstand live loads caused by pressure and suction of wind, acting normal to plane of system as calculated in accordance with building code.
- .2 AAMA/WDMA/CSA 101/I.S.2/A440-11 performance class as follows:
 - .1 Fixed windows: CW.
 - .2 Operable windows: CW.
- .3 Unless specified otherwise, glazing systems shall be designed to the following standards and references:

Aluminum Framed Glazing Systems

- .1 IGMA 'North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use'.
- .2 GANA 'Glazing Manual'.
- .3 GANA 'Sealant Manual'.
- .4 American Architectural Manufacturers Association (AAMA).
- .4 Removal and replacement of broken lites of glass shall be possible without cutting metal or moving the main frame in relation to the anchors.
- .5 Design glazing system and framing to prevent thermal shock and edge pressure fracture damage to the glass.
- .6 Metal faces of flashings, caps, framing shall be visually flat.
- .7 Accurately shape mullion and cover caps at intersecting joints to obtain hairline joints, just wide enough to permit thermal movements.
- .8 Anchor design:
 - .1 Design anchors of the framing members to the building support to accommodate movements specified herein and to allow for construction tolerances.
- .9 Noise:
 - .1 The *Work* shall be designed so that movements specified herein are accommodated without any audible noise being generated. In general, noise is produced by metal to metal contacts, and/or stresses being built up by movements and suddenly being relieved when friction forces are overcome.
- .10 Conceal fasteners connecting and fixing the framing members.
- .11 Framing cavity shall be compartmentalized every 6000 mm (236") horizontally and at corners to prevent the movement of air, in accordance with standard rain screen design.
- .12 Framing cavity shall be compartmentalized at demarcation of interior and exterior building envelope spaces to prevent the movement of air, in accordance with rain screen design.

2.5 Performance/Design Requirements - Structural

- .1 Design components to the relevant sections of the building code, using limit states design methods.
- .2 Glass shall be designed according to CAN/CGSB 12.20-M89, except where greater requirements are specified. For the purposes of glass design, wind loads shall be taken to have a minimum duration of 60 seconds.
- .3 Design of framing systems shall include necessary adjustments to wall thickness of mullions, mullion reinforcing or other necessary structural design to comply with the above stated profiles. Such design measures shall not relieve the *Contractor* of achieving other requirements.
- .4 Movement Criteria: the *Work* shall be designed and constructed so as to allow for movements of the *Work* and/or supporting structure as follows:
 - .1 Expansion and contraction of component materials of the *Work* produced by an exterior surface temperature range of -35°C to +60°C.
 - .2 Structural and thermal movements of the reinforced concrete and structural steel as prepared by the *Consultant's* structural engineers.
 - .3 For work connected to adjacent floor slabs the design shall accommodate total differential slab to slab movement of 16 mm (5/8") unless otherwise indicated.

- .4 The above movements to be accommodated without overstressing components in the *Work*, and without buckling, failure of weather seals, undue stress on glass, glass breakage, undue stress on structural elements, or other detrimental effects.
- .5 Aluminum framing members shall be designed according to CAN/CSA-S157-05/S157.1-05.
- .6 Window framing; deflection Limits:
 - .1 The deflection of framing member in direction normal to plane of glass when subjected to uniform load deflection test in accordance with ASTM E330/E330M-14, under specified design loads, shall not exceed 1/175 of clear span clear spans up to 4110 mm (13'-6") and to 1/240 of clear span plus 6.4 mm (1/4") for spans greater than 4110 mm (13'-6") or an amount that restricts edge deflection of individual glazing lites to 19 mm (3/4"), whichever is less.
 - .2 In the plane of the wall, deflection of framing members shall not reduce the glass or panel bite below 75% of the design dimension and shall not reduce the glass or panel edge clearance below 25% of the design dimension or 3 mm (1/8") whichever is greater. Restrict dimensions further if required for assembly, fit of components or to accommodate movements specified herein.
 - .3 For the work of this section, air barrier components, including sealants and membranes shall not fail under design conditions. Failure shall include loss of adhesion, excessive deflection, movement or displacement beyond product limitations, materials placed under stress beyond manufacturers recommended range.
- .7 Design structural steel structural components and fasteners in accordance with CSA-S16-14.
- .8 The design of the structural action of glazing systems shall be "simply supported" and shall not induce bending moment or thrust reactions into the building.
- .9 Design systems to withstand own dead load, snow, ice and wind loads and combination thereof, as calculated in accordance with the building code, to maximum allowable deflection without permanent deformation.
- .10 Design systems to have a method of attachment to the structure that will take into account peculiarities at the *Place of the Work* so that there shall be no possibility of site and air vibrations or normal temperature movements of the building to loosen, weaken, or fracture the connection between building envelope assembly components and the structure or between the components themselves.
- .11 Assembly shall be secured in a manner that will keep stresses on sealant within the sealant manufacturer's recommended working range.
- .12 Uniform Load: No principal member shall display undue effects or permanent set in the framing members in excess of 0.2% of their clear spans after being subjected to structural load test equal to 1.5 times the specified design load, when tested in accordance with ASTM E330/E330M-14.
- .13 Deflection Limits:
 - .1 The deflection of framing member in direction normal to plane of glass when subjected to uniform load deflection test in accordance with ASTM E330/E330M-14, under specified design loads, shall not exceed 1/175 of clear span clear spans up to 4110 mm (13'-6") and to 1/240 of clear span plus 6.4 mm (1/4") for spans greater than 4110 mm (13'-6") or an amount that restricts edge deflection of individual glazing lites to 19 mm (3/4"), whichever is less.

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- .2 In the plane of the wall, deflection of framing members shall not reduce the glass or panel bite below 75% of the design dimension and shall not reduce the glass or panel edge clearance below 25% of the design dimension or 3 mm (1/8") whichever is greater. Restrict dimensions further if required for assembly, fit of components or to accommodate movements specified herein.
- .3 For the work of this section, air barrier components, including sealants and membranes shall not fail under design conditions. Failure shall include loss of adhesion, excessive deflection, movement or displacement beyond product limitations, materials placed under stress beyond manufacturers recommended range.
- .14 Glazing that extends to a dimension of less than 1070 mm (42") above the adjacent finished floor level which is greater than 600 mm (24") above the ground on the exterior or interior of the building, shall have the glass, mullions and connections be designed as a guard to the following:
 - .1 The building code requirements for guards.
 - .2 The building code requirements for glazing subject to human impact.
- .15 Design structural steel structural components and fasteners in accordance with CSA-S16-14.
- .16 The design of the structural action of glazing systems shall be "simply supported" and shall not induce bending moment or thrust reactions into the building.
- .17 Design systems to withstand own dead load, snow, ice and wind loads and combination thereof, as calculated in accordance with the building code, to maximum allowable deflection without permanent deformation.
- .18 Design systems to have a method of attachment to the structure that will take into account peculiarities at the *Place of the Work* so that there shall be no possibility of site and air vibrations or normal temperature movements of the building to loosen, weaken, or fracture the connection between building envelope assembly components and the structure or between the components themselves.
- .19 Assembly shall be secured in a manner that will keep stresses on sealant within the sealant manufacturer's recommended working range.
- .20 Uniform Load: No principal member shall display undue effects or permanent set in the framing members in excess of 0.2% of their clear spans after being subjected to structural load test equal to 1.5 times the specified design load, when tested in accordance with ASTM E330/E330M-14.

2.6 Performance/Design Requirements - Air Filtration and Water Resistance

- .1 Windows framing systems:
 - .1 Fixed glazing assemblies:
 - .1 Air infiltration: Maximum 0.5 L/s/m² (0.10 cfm/ft²) of glazing area when tested in accordance with ASTM E283-04 at test pressure of 75 Pa (1.57 psf).
 - .2 Air exfiltration: Maximum 0.5 L/s/m² (0.10 cfm/ft²) of glazing area when tested in accordance with ASTM E283-04 at test pressure of 75 Pa (1.57 psf).
 - .3 Water penetration resistance: determined in accordance with CSA-A440S1, but not less than the minimum for specified performance class, driving rain wind pressure of 20% of design wind load and not less than 240 Pa minimum.
 - .2 Operable window glazing assemblies:
 - .1 Air infiltration: Maximum 0.5 L/s/m² (0.10 cfm/ft²) of glazing area when tested in accordance with ASTM E283-04 at test pressure of 75 Pa (1.57 psf).

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- .2 Air exfiltration: Maximum 0.5 L/s/m² (0.10 cfm/ft²) of glazing area when tested in accordance with ASTM E283-04 at test pressure of 75 Pa (1.57 psf).
- .3 Water penetration resistance: determined in accordance with CSA-A440S1, but not less than the minimum for specified performance class, driving rain wind pressure of 20% of design wind load and not less than 240 Pa minimum.
- .3 Forced entry resistance: AAMA 1304.
- .2 Entrance assemblies air infiltration/exfiltration rate:
 - .1 Fixed glazing: Maximum 0.3 L/s/m² (0.06 cfm/ft²) of glazing area when tested in accordance with ASTM E283-04 at test pressure of 75 Pa (1.57 psf) 300 Pa (6.27 psf).
 - .2 Single entrance doors: Maximum 2.54 L/s/m² (0.5 cfm/ft²) when tested in accordance with ASTM E283-04, at a pressure differential of 75 Pa (1.57 psf).
 - .3 Paired entrance doors: Maximum 5.08 L/s/m² (1.0 cfm/ft²) when tested in accordance with ASTM E283-04, at a pressure differential of 75 Pa (1.57 psf).
- .3 Water resistance:
 - .1 Static; fixed and operable glazing: No water penetration shall occur when the work is tested in accordance with ASTM E331-00, amended to prohibit water from passing through interior glazing seals or frame joints, at a test pressure equal to 20% of positive design wind pressure and but not less than 300 Pa (6.27 psf).
- .4 Design glazing systems using rain screen principle with the following characteristics:
 - .1 Interior (room-side) air seal at component interfaces.
 - .2 Exterior (weather-side) deterrent seal formed by continuous gaskets or flush silicone seal as applicable.
 - .3 Glazing pockets vented and drained to the exterior.
 - .4 Extrusions with integral gutters of sufficient depth to carry intruded rainwater and snow-melt to the exterior.
 - .5 System of baffles to prevent water entering the glazing cavity due to gravity, capillary action or rain momentum.
 - .6 Metal to metal joints within the glazing cavity shall be designed and installed to be sealed prior to assembly and fixing and so as to provide continuous drainage of water to points of egress from assembly. Where location of drainage must drain more than one lite and/or spandrel, the number of drainage holes shall be increased according to rain screen design principle.
- .5 Cap and seal exposed ends of mullions and caps, while not compromising drainage qualities.

2.7 Performance/Design Requirements - Thermal

- .1 No condensation or frost shall form on the interior of glazing or framing members when tested under the following conditions:
 - .1 Interior air: 22°C, 30% R.H.
 - .2 Exterior air: -20°C, 24 km/h (15 ml/h) wind speed.
- .2 In addition to the above requirements the framing system shall be designed such that condensation or frost will not form on the interior surface of the aluminum members before appearing on the adjacent insulating glass units. To achieve this requirement, any metal on the exterior of the *Work* will require a thermal break between metal on the interior.

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- .3 Brackets and attachment shall not cause thermal bridging resulting in interior condensation forming at design conditions.

2.8 Materials

- .1 Glass: in accordance with Sections 08 80 00.
- .2 Aluminum extrusions: Accurately formed, extruded aluminum alloy ASTM B221-14: AA-6063-T5/T6, free from defects impairing appearance, strength and durability.
 - .1 Minimum thickness of 3 mm (0.125") for framing members, and 1.27 mm (0.050") for glazing stops, snap caps and similar components unless indicated otherwise.
- .3 Aluminum flashing:
 - .1 Minimum wall thickness: 0.812 mm (0.0320")(20 B&S gauge), unless otherwise indicated.
 - .2 Aluminum alloy:
 - .1 For anodized finish:
 - .1 ASTM B209-14: AA5005-H34 Anodizing Quality.
- .4 Shims: Utility grade aluminum sheet when not in contact with concrete; stainless steel when in contact with concrete or cementitious substances of thickness required, or galvanized steel.
- .5 Fasteners:
 - .1 Non-magnetic (austenitic) 300 series alloy stainless steel unless otherwise indicated.
 - .2 Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - .3 Provide nuts or washers of design having means to prevent disengagement; deforming of fastener threads is not acceptable.
 - .4 Provide concealed fasteners unless indicated otherwise.
 - .5 For exposed locations, provide countersunk flathead fasteners with finish matching item fastened.
- .6 Anchors: Three-way adjustable anchors with minimum adjustment that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - .1 Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M-13 or ASTM A153/A153M-09 requirements.
- .7 Dielectric separator: Non-staining alkali resistant, rubber isolation pads or 10 mil vinyl membrane type, electrolytic isolation factor of 1.0.
- .8 Internal sealant and air barrier sealant: One-part, neutral cure, high performance silicone sealant complying with ASTM C920-14, Type S, Grade NS, Class 25, capable of sustaining dynamic movements, SWRI sealant validated.
- .9 Zinc-rich coating: Touch-up paint for welded galvanized areas; 2 coats of zinc-rich paint to CAN/CGSB 1.171-98, VOC <340 g/L.
- .10 Thermal barrier component:
 - .1 Rigid polyvinyl chloride or neoprene or polyurethane providing full separation of interior and exterior components. Thickness shall be as required to meet design.

- .2 Glass fibre reinforced polyamide porthole extrusion providing full separation of interior and exterior components. Thickness shall be as required to meet design.
- .11 Miscellaneous steel: CSA G40.21-13, Grade 300W.
 - .1 Finishes:
 - .1 Behind air/vapour barrier: CISC/CPMA 2-75 primer.
 - .2 Exterior to air/vapour barrier, and where condensation could occur: hot dip galvanized after fabrication or Type 300 series stainless steel.
 - .12 Spacers for glazing sections receiving metal flashed, panels; behind pressure plate: High density polyethylene (HDPE) or PVC.
 - .13 Foamed-in-place insulation: One-component CFC-free polyurethane foam for thermal insulation around exterior framing assemblies (Gap Filler) to CAN/ULC S710.1-11.

2.9 Finishes

- .1 Exposed aluminum surfaces; anodized to AAMA 611-20:
 - .1 Colour anodized to AA Designation AA-M12C21A44 or AA-M12C22A44 (Class I).
 - .1 Dark Bronze, to match existing.
 - .2 Finish exposed metal fasteners: baked-on finish to match related aluminum surfaces.
 - .3 Finish steel clips and reinforcing steel with 610 g/m² zinc coating to ASTM A123/A123M-09.

2.10 Fabrication - General

- .1 Insofar as practical, execute fitting and assembly in the shop with the various parts or assemblies ready for erection at the *Place of the Work*.
- .2 Take field measurements and levels required to verify or supplement those shown for the proper layout and installation of the *Work*. Coordinate dimensional tolerances in adjacent building elements and confirm prior to the commencement of the work of this section. Commencement of installation floor by floor shall be construed as acceptance of building conditions. Glazing systems shall not deviate from tolerances specified.
- .3 Verify measurements at the *Place of the Work* and fabricate systems to suit dimensions at the *Place of the Work*.
- .4 Conceal nuts, bolts, screws, clips and other means of fastening in finished *Work*, except where shown or specified otherwise.
- .5 Maintain dimensional tolerances from vertical and horizontal planes with the closest possible accuracy for the various parts as previously designated.
- .6 Means of anchoring systems shall have sufficient adjustment to permit correct and accurate alignment. After adjustment, positively lock anchorage devices in manner to preclude movement, once alignment is achieved.
- .7 Isolate aluminum bearing contact with dissimilar materials other than air/vapour seal. Method of isolation shall be to *Consultant's* acceptance.
- .8 Make allowances for deflection of structure above when making connection thereto, and ensure that no structural load is transmitted to glazing systems.
- .9 Fixing screws shall be countersunk and concealed. Screws shall be oval head, set flush with adjacent surfaces.

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- .10 Assume full responsibility for the design of assemblies. Reinforcing, furring and anchoring shall suit each specific condition complying with the parameters previously specified, required and as shown.
- .11 Form accurate extrusions with clean, straight, sharply defined profiles free from any defects.
- .12 Form flashing bends with clean, straight, sharply defined profiles without damage and discolouration to finish.
- .13 Extrusion thickness shall be adequate to satisfy loading and deflection, as required and indicated.
- .14 Weld aluminum where required with inert metal arc equipment by methods recommended by the Aluminum Co. of Canada. Welders shall qualify according to CSA W47.2-11(R2015). Make exposed welds continuous and flush with adjacent surface. Do not mar surface finishes with welds in back of exposed aluminum. Do not deform the exposed metal and finish in any way by welding.
- .15 Weld steel, where required, in accordance with CSA W59-13. Welded joints shall be of adequate strength and durability with jointing tight and flush. Welder shall be fully approved by the Canadian Welding Bureau and shall comply with CSA W47.1-09(R2019), Division 3. Where it is necessary to weld components already galvanized, remove galvanizing for 50 mm (2") around weld and paint over welds where galvanizing is removed as specified hereinafter.
- .16 Insert concealed prime painted steel reinforcement into cavities of frame members to the interior side of integral air seal web, sized to adequately withstand wind pressure requirements specified.
- .17 Include aluminum cover plates, trim components, bent plates, closure trim, extruded glazing corner posts, drips, flashings and other components required to complete the installation and as indicated whether specifically labelled/dimensioned or only notionally indicated.
- .18 Trim glazing spline at continuous embedded sill flashing locations (to ensure full upturn of flashing) behind pressure plate.
- .19 Include thermal barriers, and miscellaneous neoprene pads, shims and washers.
- .20 Metal-to-metal joints which require sealing to maintain weathertightness shall be designed and assembled with a ribbon of sealant that shall be compressed by approximately 50% of its original thickness when the joints are secured.
- .21 Fabricate frame systems complete with mullions, head and sill frames, spigots, and plugs for horizontals, spline gaskets, thermal break pressure plates, filler pieces, snap-on caps, and other necessary components.
- .22 Sill flashing:
 - .1 Extruded aluminum, finished to match window frames.
 - .2 Project 25 mm (1") minimum drip projection beyond wall surface unless indicated otherwise.
 - .3 *Provide* preformed drip deflectors for sill ends at jambs to direct water drainage within sill zone.
 - .4 *Provide* preformed butt joint and corner sill splice connectors and sealant to prevent water penetration; butt joint connectors shall only be permitted when required by design requirements and to industry standard maximum lengths. Locate splice connectors (joint covers) at center line of mullions when required. Trim and detail corners uniformly flush.

2.11 Fabrication Tolerances

- .1 Comply with the following maximum tolerances:
 - .1 Plumb: 3.2 mm in 3 m (1/8" in 10'-0"); 6.35 mm in 12.2 m (1/4" in 40'-0").
 - .2 Level: 3.2 mm in 3 m (1/8" in 10'-0"); 6.35 mm in 12.2 m (1/4" in 40'-0").

- .3 Alignment:
 - .1 Where surfaces abut in line or are separated by reveal or protruding element up to 12.7 mm (1/2") wide, limit offset from true alignment to 1.6 mm (1/16").
 - .2 Where surfaces are separated by reveal or protruding element from 12.7 to 25.4 mm (1/2" to 1") wide, limit offset from true alignment to 3.2 mm (1/8").
 - .3 Where surfaces are separated by reveal or protruding element of 25.4 mm (1") wide or more, limit offset from true alignment to 6.4 mm (1/4").
 - .4 Variation from plane: 3.2 mm in 3.6 m (1/8" in 12'-0"); 12.7 mm (1/2") over total length.
 - .5 Square or rectangular: Maximum 3.2 mm (1/8") difference between diagonal measurements.
 - .6 Variation from indicated position: plus/minus 3 mm (1/8").
- .2 Tolerances shall not be cumulative.

PART 3- EXECUTION

3.1 Installation - General

- .1 Verify dimensions of supporting structure by measurement at the *Place of the Work* so that aluminum framed glazing systems will be accurately designed, fabricated and fitted to the structure.
- .2 Coordinate with the work of other sections and hand-over items to be placed during the installation of other work at the proper time to avoid delays in the *Work*.
- .3 Erect frames complete with necessary reinforcing and incidental components.
- .4 Include anchors and fastenings shown, specified, or necessary to anchor work together or to work of separate sections. Supply items and inserts required to be built into other work. Submit instructions for proper location, and verify proper positioning. Survey location of imbeds after initial pour to verify tolerances.
- .5 Use anchors that will permit sufficient adjustment for accurate alignment.
- .6 Accurately fit and rigidly frame together units where required. Match components carefully to produce continuity of line and design. *Provide* flush hairline joints and weathertight connections.
- .7 Ensure adequate clearance and shim space at perimeter of openings.
- .8 After welding galvanized steelwork, touch-up weld areas with 2 coats of primer, zinc-rich at galvanized locations.

3.2 Installation Tolerances

- .1 Comply with the following maximum tolerances:
 - .1 Plumb: 3.2 mm in 3 m (1/8" in 10'-0"); 6.35 mm in 12.2 m (1/4" in 40'-0").
 - .2 Level: 3.2 mm in 3 m (1/8" in 10'-0"); 6.35 mm in 12.2 m (1/4" in 40'-0").
 - .3 Alignment:
 - .1 Where surfaces abut in line or are separated by reveal or protruding element up to 12.7 mm (1/2") wide, limit offset from true alignment to 1.6 mm (1/16").
 - .2 Where surfaces are separated by reveal or protruding element from 12.7 to 25.4 mm (1/2" to 1") wide, limit offset from true alignment to 3.2 mm (1/8").

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- .3 Where surfaces are separated by reveal or protruding element of 25.4 mm (1") wide or more, limit offset from true alignment to 6.4 mm (1/4").
- .4 Variation from plane: 3.2 mm in 3.6 m (1/8" in 12'-0"); 12.7 mm (1/2") over total length.
- .5 Square or rectangular: Maximum 3.2 mm (1/8") difference between diagonal measurements.
- .6 Variation from indicated position: plus/minus 3 mm (1/8").
- .2 Tolerances shall not be cumulative.

3.3 Foamed-in-Place Insulation

- .1 Install between aluminum framing and rough openings at exterior walls and where indicated in accordance with CAN/ULC S710.2-11 application standard.

3.4 Isolation

- .1 Backpaint aluminum surfaces in contact with cement, concrete, masonry, plaster or dissimilar metals with heavy coat of bituminous paint.

3.5 Glass and Glazing

- .1 Furnish glass for work of this section to requirements herein and in accordance with Section 08 80 00, and assume total responsibility for sizing, design and other aspects of glass work and accessories.
- .2 Wherever practicable, factory install glass associated with doors of this section in accordance with requirements stipulated under Section 08 80 00, except as otherwise indicated herein.

3.6 Sealant - Installation

- .1 *Provide* sealants associated with this section, following the requirements of Section 07 92 00. Make entire installation watertight.

3.7 Finishing Hardware - Installation

- .1 Install finishing hardware in accordance with Section 08 71 00.
 - .1 Hinges:
 - .1 Install hinges spaced accordingly with drawings.

3.8 Field Quality Control – Subcontractor

- .1 Be responsible for quality control of the work of this section including quality control of sub-*Subcontractors* and material suppliers for work of this section.
- .2 Submit written certification by a Professional Engineer registered in *Place of the Work* stating that the glazing systems have been designed in accordance with design and performance requirements specified.

3.9 Field Quality Control – Field Review

- .1 Field review programme to include:
 - .1 Review of exterior sealants etc.
 - .2 Checks for continuity of insulation plane.
 - .3 Verification of flashing placement and continuity.

- .4 Review of exterior applied sealants and flashings.
- .5 Confirmation of fastener size, type, and material
- .6 Review of drainage paths to confirm clear.
- .7 Verification of glass type and position

3.10 Adjusting and Cleaning

- .1 Adjust operating hardware and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
- .2 Remove as the work of this section progresses, corrosive and foreign materials which may set or become difficult to remove at time of final cleaning or which may damage members. Inspect as often as required to ensure cleanliness.
- .3 Remove non-permanent labels.
- .4 Remove dirt and residue from surfaces.
- .5 Remove *Products* or materials that have been broken, chipped, cracked, discoloured, abraded, or damaged during construction period and *Provide* undamaged *Products* or materials meeting the requirements of the *Contract Documents*.
- .6 Wash exposed surfaces with a cleaning solution approved by *Product* manufacturers.

3.11 Protection

- .1 At completion of the *Work*, remove protective coatings, clean glass and aluminum and remove surplus compounds and sealant materials. Replace or make good defective, scratched or damaged work.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

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

1.2 Administrative Requirements

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

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

Finish Hardware

.2 Schedules and samples:

- .1 Prepare and submit for review, a finish hardware schedule with technical product data sheets for use in the *Work*. List type, selected manufacturer's name and number, location, mounting heights and finish of hardware, and complete cross reference to door schedule.
- .2 The indication or omission of a hardware component on the hardware schedule does not remove the responsibility of this section to ensure that all hardware can be installed and will function as intended.
- .3 Submit samples of complete line of hardware and finishes. Identify samples indicating hardware item numbers used in the Finish Hardware Schedule, manufacturer's numbers, names, types, finishes, sizes and indication of door location(s). Approved samples will be retained for comparisons and returned upon completion of the *Work*.
- .4 Prepare and submit for review, a keying schedule recognizing *Owner* requirements which shall be determined after award of *Contract*.

.3 Templates:

- .1 Submit for distribution, 3 copies of templates, template information, installation instructions and details necessary to enable preparation for, and installation of finish hardware in accordance with Door Hardware Institute recommended procedures. Submit templates arranged and marked coincident with specified hardware designations.
- .2 Submit promptly when requested, the foregoing information in 3-ring plastic hard-covered binders suitably identified.

.4 Jigs:

- .1 Submit template jigs for each component to be recessed to enable installation trades to prepare doors to preclude misalignment and improper fit.

1.4 Closeout Submittals

.1 Operation and maintenance data:

- .1 Instruct the *Owner's* designated representative in proper care and preventative maintenance of hardware to assure longevity of operation.
- .2 Submit maintenance data for cleaning and maintenance of finish hardware.

.2 Submit to building maintenance staff prior to date of *Substantial Performance*, two sets of wrenches for door closers, locksets and fire exit hardware.

1.5 Quality Assurance

.1 Qualifications: *Provide* work of this section, executed by competent *Supplier* in *Products*, systems and assemblies specified and with approval of *Product* manufacturers.

- .1 Finish Hardware Supplier's project manager shall be directed involved in the day to day management of the project and shall be an accredited Architectural Hardware Consultant (AHC).

1.6 Delivery, Storage, and Handling

- .1 Package each item of hardware individually, complete with trim and necessary fastenings, and accessories, including wrenches, keys, and other appurtenances required to ensure correct installation. Mark each item as to contents and appropriate use in specified groups.

Finish Hardware

- .2 All items of hardware subject to handling when installed shall be submitted with an easily removable covering to protect against scratches, abrasions, coating with dissimilar finish materials on adjacent surfaces, and tarnishing.

1.7 Extended Warranty

- .1 Warrant work of this section for a period of 2 years. In addition provide:
 - .1 Warranty period with regard to the work of this section with regard to the closers is 5 years.
 - .2 Provide manufacturer's standard extended warranties.

PART 2- PRODUCTS

2.1 Performance/Design Requirements

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

2.2 Materials

- .1 Finish hardware: in accordance with 08 44 00.
- .2 Finish hardware manufacturer is Best Hardware' unless otherwise indicated. Hardware shall be fabricated of same materials and shall have consistent colour and finish throughout Project and fully comply with the *Owner's* standards.

PART 3- EXECUTION

3.1 Examination

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

3.2 Installation

- .1 Install in accordance with manufacturer's written installation requirements. Refer also to installation requirements indicated, and specified in other sections of specifications.
- .2 Accurately locate and adjust hardware to meet manufacturer's written requirements. Use special tools and jigs as recommended.
- .3 Locate door stops to contact doors 75 mm (3") from latch edge.
- .4 Take delivery of finishing hardware and install, except hardware specified as part of work of another section. Check each item as received.
- .5 Set, fit and adjust hardware according to manufacturer's directions, at heights later directed by *Consultant*. Hardware shall operate freely. Protect installed hardware from damage and paint spotting.
- .6 Sound and weather seals:

Finish Hardware

- .1 Install seals to continuously seal entire perimeter of doors. Secure in place with non-ferrous screws, in accurate alignment.
- .2 Maintain integrity of seal at head of doors fitted with closers. Adapt seals as required to achieve specified performance.
- .7 Pre-drill kickplates and doors prior to installation of kickplates. Apply with water-resistant adhesive and countersunk stainless steel screws.
- .8 Set thresholds on two continuous beads of polyurethane caulking fastened with a minimum of 4 countersunk screws.

3.3 Keying

- .1 Provide key cylinder matching existing master keying system.
 - .1 Only the front doors at main entrance to have a cylinder lock, all other doors not to be keyed from the exterior.

3.4 Field Quality Control

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

3.5 Adjusting and Cleaning

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

END OF SECTION

PART 1- GENERAL

1.1 Summary

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

1.2 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .2 Shop drawings:
 - .1 Show details of each type of glazing system in conjunction with the framing system indicating type of glass, sizes, shapes, glazing material and quantity. Show details indicating glazing material, glazing thickness, bite on the glass and glass edge clearance.
- .3 Test and evaluation reports:
 - .1 Obtain compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealant as well as other glazing materials including insulating units.
- .4 Manufacturer reports:
 - .1 Submit glass fabricator's product information and structural calculations indicating compliance with glazing standards established by the Glass Association of North America (GANA). Submittal to include thermal stress and structural load analysis of the proposed glass types, configuration and sizes.
- .5 Submit sample glazing warranty.
 - .1 Submit letter from insulating glass unit fabricator that insulating glass units supplied will bear the certification mark of IGMAC or IGCC/IGMA.

1.3 Closeout Submittals

- .1 Operation and maintenance data:
 - .1 Submit maintenance and cleaning instructions for glass and glazing for incorporation into the operating and maintenance manuals.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers: Fabrication processes, including low emissivity and reflective coatings, insulating, laminated, silk-screening and tempering shall be manufactured by a single manufacturer meeting ANSI / ASQC 9002 1994.
 - .2 Installers / applicators / erectors: *Provide* the work of this section executed by specialist *Subcontractor* who shall be thoroughly trained and experienced in skills required, be completely familiar with referenced standards and requirements of the work of this section, and personally direct installation performed under this section.
 - .3 Aspects of the work of this section are required to be prepared by a professional engineer. Refer to Section 01 33 00 for specific details and requirements in this regard.

Glass and Glazing

1.5 Delivery, Storage, and Handling

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

1.6 Field Conditions

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

1.7 Extended Warranty

- .1 Special product warranty for coated-glass products:
 - .1 Provide written 10 year warranty from date of manufacture for sputter coated glass. Warranty shall cover deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer's published instructions. Warranty shall be manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units.
- .2 Special product warranty for laminated glass products:
 - .1 Provide written 5 year warranty from date of manufacture for laminated glass. Warranty shall cover deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer's published instructions. Warranty shall be manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units.
- .3 Special product warranty for tempered glass products:
 - .1 Provide a written 5 year warranty from date of manufacture for fully tempered glass. Warrant that tempered glass will not break spontaneously as a result of Nickel Sulfide (NiS) inclusions at a rate exceeding 0.8% (8/1000) for a period of five years from the date of manufacture. Warranty shall be manufacturer's standard form in which tempered-glass manufacturer agrees to replace tempered-glass units.

PART 2- PRODUCTS

2.1 Performance/Design Requirements

- .1 General:
 - .1 Publications: Comply with recommendations in the publications below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section.
 - .1 GANA Glazing Manual.
 - .2 GANA Engineering Standards Manual.
 - .3 GANA Laminated Glazing Reference Manual.

Glass and Glazing

.4 GANA Sealant Manual.

.2 Glass strength:

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

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

.2 1 break per 1000 for glass guards and railings.

.2 Maximum lateral deflection; insulating glass units:

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

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

.3 Glass thicknesses and glass types specified, indicated, or scheduled in the *Contract Documents* are minimums required. Glass designer/engineer to modify as required to satisfy design and building code requirements, and requirements of authorities having jurisdiction, and any such modifications shall be clearly indicated on shop drawings.

.3 Glazing systems shall be capable of withstanding normal thermal movements, without failure, including loss due to defective manufacture, fabrication and installation; deterioration of glazing materials; and other defects in construction.

.4 Protect laminated glass interlayer from damage or discolouration resulting from contact with deleterious and incompatible sealants, substances, and materials. Comply with manufacturer's recommended installation requirements.

2.2 Glass Manufacturers

.1 Subject to compliance with the requirements of the Contract Documents, provide primary glass by one of the following float glass manufacturers:

.1 AGC Glass North America.

.2 Cardinal Glass Industries.

.3 Guardian Industries, LLC.

.4 Pilkington North America.

.5 Vitro Architectural Glass.

2.3 Glass Materials

.1 General:

.1 Single source responsibility: *Provide* materials from a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source and manufacturing plant for each type and class required.

.2 Insulating glass units:

.1 Warm edge, hermetically sealed, CAN/CGSB 12.8-97 or ASTM E2190-10, minimum 12 mm (1/2") air space, air filled, double sealed edges (primary to be polyisobutylene, secondary to be polysulphide, silicone in the structural silicone glazed units), desiccant filled warm edge spacer (splice connectors at corner of each glass unit).

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- .1 Warm edge spacer:
 - .1 Stainless steel: RPM Rollforming 'ST-2000', Allmetal 'SST', Fenzi 'Rolltech Stainless Steel'.
 - .2 Vinyl faced, electrolytic tin plated steel: Fenzi 'Warmedge'.
 - .1 Spacer bar colour:
 - .1 Black.
- .2 Grey coloured polyisobutylene shall not be acceptable.
- .3 Edge delete low 'E' coating down to bare glass in accordance with manufacturer's written requirements. Deletion shall be continuous around the entire periphery of glass edges to minimum deletion width from edge of glass to at least 50% through the primary sealant bead width.
- .4 Set spacer bare evenly into glass units to maximum variation of +/- 2.0 mm (0.080")/length of spacer bar. Primary sealant shall not extend past spacer bar greater than 1.5 mm (0.060").
- .5 IGMAC or IGCC/IGMA certified, permanently marked either on spacers or on at least one component lite of units with appropriate certification label.
- .6 Low 'E' coating (pyrolytic or single silver):
 - .1 Acceptable *Products*:
 - .1 Guardian SunGuard SuperNeutral 54.
- .3 Heat treated (tempered or heat strengthened) float glass:
 - .1 CAN/CGSB 12.1-M90.
 - .2 Minimum thickness: 6 mm (1/4").
 - .3 Fabrication process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - .4 For uncoated glass, comply with requirements for Condition A in accordance with ASTM C1048-18.
 - .5 For coated vision glass, comply with requirements for Condition C (other coated glass) in accordance with ASTM C1048-18.
 - .6 Heat strengthened glass shall have surface compression of 24-52 MPa (3,500-7,500 psi).
- .4 Laminated glass:
 - .1 CAN/CGSB 12.1-M90.
 - .2 Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations. Use materials that have a proven record of no tendency to bubble, discolour, or lose physical and mechanical properties after fabrication and installation.
 - .3 Glass layers minimum 5 mm (0.197") thick unless otherwise indicated.
 - .4 Interlayer thickness: Provide thickness as needed to comply with requirements and not less than the following:
 - .1 Vertical glazing: not less than 0.76 mm (0.030") unless otherwise indicated.
 - .5 Interlayer colour: Clear.

Glass and Glazing

- .6 Glass type: annealed or heat strengthened or tempered, as required to suit design requirements.
- .7 Laminated glass products to be fabricated free of foreign substances and air or glass pockets in autoclave with heat plus pressure.

2.4 Glazing Materials

- .1 Glazing materials; general: Select glazing sealants, gaskets and additional glazing materials of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
- .2 Glazing gaskets: Moulded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - .1 Preformed, EPDM to ASTM C864-05(2015).
 - .2 Preformed, EPDM, silicone compatible, to ASTM C864-05(2015).
 - .3 Preformed silicone to ASTM C1115-17.
- .3 Setting blocks: Moulded or extruded material with Shore, Type A Durometer hardness of 85, plus or minus 5, made from one of the following:
 - .1 Preformed, EPDM to ASTM C864-05(2015).
 - .2 Preformed, EPDM, silicone compatible, to ASTM C864-05(2015).
 - .3 Preformed silicone to ASTM C1115-17.
- .4 Spacers: Moulded or extruded blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated made from one of the following:
 - .1 Preformed, EPDM to ASTM C864-05(2015).
 - .2 Preformed, EPDM, silicone compatible, to ASTM C864-05(2015).
 - .3 Preformed silicone to ASTM C1115-17.
- .5 Edge blocks: Moulded or extruded material of hardness needed to limit glass lateral movement (side walking) made from one of the following:
 - .1 Preformed, EPDM to ASTM C864-05(2015).
 - .2 Preformed, EPDM, silicone compatible, to ASTM C864-05(2015).
 - .3 Preformed silicone to ASTM C1115-17.
- .6 Cleaners, primers and sealers: Type recommended by sealant or gasket manufacturer.

2.5 Fabrication of Glazing Units

- .1 Fabricate glazing units in sizes required to fit openings, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - .1 Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
- .2 Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

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- .3 Grind smooth and chamfer, and polish exposed glass edges and corners.

PART 3- EXECUTION

3.1 Examination

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

3.2 Preparation

- .1 Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- .2 Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.
- .3 Clean contact surfaces with solvent and apply primers to surfaces to receive tapes and sealants in accordance with the manufacturer's requirements. Ensure surfaces are free of moisture and frost.

3.3 Glazing - General

- .1 Comply with combined written requirements of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- .2 Adjust glazing channel dimensions as required by conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- .3 Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- .4 Clean glazing rebate surfaces of traces of dirt, dust, or other contaminants.
- .5 Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- .6 Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- .7 Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

Glass and Glazing

- .8 Provide spacers for glass lites where length plus width is greater than 1270 mm (50").
 - .1 Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - .2 Provide 3.2 mm (1/8") minimum bite of spacers on glass and use thickness equal to sealant width.
- .9 Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel.
- .10 Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- .11 Set glass lites with proper orientation so that coatings face exterior or interior as specified.

3.4 Gasket Glazing (Dry)

- .1 Allow gaskets to relax and cut compression gaskets to lengths recommended by gasket manufacturer to fit openings to suit frame dimensions.
- .2 Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- .3 Installation with drive-in wedge gaskets: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centres of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- .4 Installation with Pressure-Glazing Stops: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- .5 Install gaskets so they protrude past face of glazing stops.

3.5 Adjusting and Cleaning

- .1 Immediately remove sealant and compound droppings from finished surfaces. Remove labels after work is completed.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Metal support systems for interior gypsum board partitions and interior assemblies.

1.2 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the *Work* of this section, including additional data as may be required to demonstrate compliance with the *Contract Documents*.
- .2 Test and evaluation reports:
 - .1 Submit certified test results for each required fire resistance rated assembly for work of this section.

1.3 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 *Provide* work of this section, executed by a *Subcontractor* in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

PART 2- PRODUCTS

2.1 Performance/Design Requirements - Fire Resistance Rated Assemblies

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

2.2 Materials - General

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

2.3 Partition Support Materials

- .1 Interior non-loadbearing channel stud framing: to ASTM C645-18; roll formed from 0.455 mm (0.0179") minimum thickness unless otherwise indicated or as recommended by gypsum board manufacturer, galvanized steel sheet. Provide service holes starting at 450 mm (18") from bottom, then 914 mm (36") on centre to top of studs.
 - .1 Steel studs at abuse resistant gypsum board locations: 0.836 mm (0.0329") minimum thickness.
 - .2 Steel studs at tile backer board locations: 0.836 mm (0.0329") minimum locations.

2.4 Furring

- .1 Furring channels: 0.455 mm (0.0179") minimum typical thickness, cold rolled steel, wiped coated, nominal size of 22 mm (7/8") depth x 35 mm (1-3/8") face, hat type with knurled face.

2.5 Accessories

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

PART 3- EXECUTION

3.1 Installation General

- .1 Comply with ASTM C754-20 and manufacturer's requirements, except as modified herein. Do not bridge building expansion joints with support system. Frame both sides of joints with furring and other supports as indicated.
- .2 Provide and install studs, framing, shimming, and furring to provide proper support for gypsum board to achieve the following installation tolerances:
 - .1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane.
 - .2 Do not exceed 10 mm (3/8") from drawings locations.
 - .3 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.
 - .4 Install each framing member so fastening surfaces vary not more than 3.2 mm (1/8") from the plane formed by faces of adjacent framing.
 - .5 In double stud walls, do not bridge across studs on opposite sides of wall with gypsum board or metal cross bracing.
- .3 Give complete cooperation and direction to trades erecting framing and furring over which this work is applied. Coordinate finished joint location with framing.
- .4 Coordinate installation and cooperate with mechanical and electrical work to accommodate mechanical electrical items and any other work required to be incorporated into or coordinated with the partitions, ceiling and soffit systems.
 - .1 Where the presence of suspended ductwork or other mechanical or electrical services or devices above ceiling framing conflicts with ceiling framing suspension points from structure above, provide bridging framing below conflicting work as required to support ceiling framing on specified intervals.

Metal Supports for Gypsum Board

- .2 Do not suspend ceiling framing from mechanical or electrical suspension systems unless agreement is obtained in writing from engineer for *Subcontractor* installing such framing that additional imposed loads are acceptable; obtain *Consultant's* acceptance before proceeding.
- .5 Provide clearances between work of this section and structural elements to prevent transference of structural loads.
- .6 Do not bridge building expansion joints with steel framing or furring members. Independently frame both sides of joints with framing of furring members or as indicated.
- .7 Size framing systems according to manufacturer's engineered load tables, to meet allowable deflection without permanent deformation.
 - .1 Maximum allowable deflection: $L/240$.

3.2 Blocking

- .1 Attach to framing adequate backer plates to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of this section.
- .2 Such items include, but are not restricted to:
 - .1 Coat hooks.
 - .2 Washroom accessories.
 - .3 Future application of grab bars.
 - .4 Cabinetry.
 - .5 Shelving.
 - .6 Glazing accessories.
 - .7 Items as indicated.

3.3 Furring - General

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

3.4 Metal Stud Partition Framing

- .1 Provide partition tracks (runners) at floor and underside of structural assembly and as follows:
 - .1 Align accurately and lay out according to partition layout.
 - .2 Secure runners to concrete, access flooring and to concrete slabs, as applicable, with screwed or shot fasteners located 50 mm (2") from each end and spaced at maximum 610 mm (24") on centre.
 - .3 At partition corners, extend one runner to end of corner and butt other runner to it, allowing necessary clearance for gypsum board thickness. Runners should not be mitred.

- .2 Unless otherwise indicated, place interior studs vertically at centres as follows:
 - .1 *Provide* studs at 400 mm (16") on centre, and as specially spaced in accordance with details indicated.
 - .2 *Provide* studs not more than 50 mm (2") from abutting walls, openings and each side of corners.
 - .3 *Provide* freedom for 19 mm (3/4") deflection under beams, structural slabs and the like to avoid transmission of structural loads to studs, or install 50 mm (2") leg ceiling tracks.
- .3 Install studs in tracks at floor and ceiling.
- .4 Where horizontal runs of service lines are scheduled to be installed, arrange with applicable trades and install studs simultaneously with services.
- .5 At openings in stud walls, erect track at head and sills to accommodate intermediate studs. At each end of track, cut out flanges, turn up web, and fasten to studs. Install intermediate studs above and below openings in same manner and spacing as wall studs. Install double studs at each jamb, and double tracks at head of door openings.
- .6 At partitions requiring fire rating, erect in accordance with requirements of listing.
- .7 Size studs, connections, and runners to carry loads according to stud manufacturer's load tables, at 24 kg/m² (5 lb/ft²) live load to meet maximum allowable deflection limits. Where depth of stud is indicated, size metal thickness to meet allowable deflection limits.
- .8 *Provide* three studs at corner and intermediate intersections of partitions.
- .9 Coordinate work with others installing horizontal runs of service lines so that work is done simultaneously. Where standard holes are too small for installed services, notch studs, and splice notched flanges with splice pieces 305 mm (12") longer than notches, each fastened with 2 screws.
- .10 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .11 Coordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other sections.
- .12 Unless otherwise indicated, partitions, together with gypsum board facings, shall extend above ceilings to underside of structure above.
- .13 Chase walls:
 - .1 *Provide* chase walls consisting of two parallel steel stud partitions.
 - .2 *Provide* cross bracing consisting of metal furring, located at quarter points on each pair of studs. Attach cross bracing to studs with metal screws.
- .14 Install steel stud reinforcement 1.720 mm (0.0677") at door frames and brace above ceiling. Secure to top and bottom structure with angle brackets and anchors.
- .15 Where ductwork passes through a fire rated wall, *Subcontractor* is to coordinate with the mechanical *Subcontractor* to obtain from the fire damper manufacturer's technical data on how the wall is to be assembled to meet the fire rating requirements that the manufacturer has tested for their damper. *Subcontractor* is not to board up this wall on both sides until *Consultant* has reviewed location and approved this installation.

3.5 Control Joints

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

END OF SECTION

Gypsum Board

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Plain gypsum board.
 - .2 Tile backer board; coated glass scrim gypsum board.
 - .3 Gypsum board accessories and miscellaneous related materials.

1.2 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .2 STC assembly ratings:
 - .1 Submit STC assembly ratings for each required STC rated assembly for work of this section.

1.3 Quality Assurance

- .1 Qualifications:
 - .1 Subcontractor executing the work of this section shall have continuous experience in successful installation of work of type and quality indicated and specified.

1.4 Delivery, Storage, and Handling

- .1 Store materials in protected dry areas. Store gypsum board flat in piles with edges protected.
- .2 Ensure that finish metal members are not bent, dented, or otherwise deformed.
- .3 Deliver *Products* supplied under the work of this section only to those who are responsible for installation, to the place they direct, and to meet installation schedules.

1.5 Field Conditions

- .1 Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum boards.
- .2 When ambient outdoor temperatures are below 12°C (55°F) maintain continuous, uniform comfortable building working temperatures of not less than 12°C (55°F) for a minimum period of 48 hours before, during and following application of gypsum board and joint treatment materials or bonding of adhesives.
- .3 Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.
- .4 Protection:
 - .1 *Provide* adequate protection of materials and work of this section from damage by weather and other causes. Protect work of other trades from damage resulting from work of this section. Make good such damage at no additional cost to the *Owner*.

Gypsum Board

- .2 Exterior sheathing board's exposure to weather: Comply with manufacturer's written requirements. Provide protection prior to exposure for periods greater than manufacturer's recommendations and warranty.

PART 2 - PRODUCTS

2.1 General

- .1 Single source responsibility: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.

2.2 Gypsum Board Panels

- .1 Plain gypsum board:
 - .1 Paper faced gypsum core panel solid set core enclosed in paper, 12.7 mm (1/2") or 16 mm (5/8") thick unless otherwise indicated, 1220 mm (48") wide x maximum practical length, ends square cut, tapered edges, to ASTM C1396/C1396M-14.
 - .2 Acceptable *Products*:
 - .1 CertainTeed 'Regular Gypsum Board'.
 - .2 CGC 'Sheetrock Brand Gypsum Panel'.
 - .3 Georgia-Pacific 'ToughRock Gypsum Board'.
 - .4 Continental Building Products 'Regular Drywall'.
 - .5 National Gypsum 'Gold Bond Gypsum Board'.
- .2 Glass scrim tile backer board:
 - .1 Glass scrim fibre faced water resistant gypsum board with moisture resistant core and fibreglass face mats and heat cured water resistant face coating to ASTM C1178/C1178M-13. 12.7 mm (1/2") or 16 mm (5/8") thick unless otherwise indicated.
 - .2 Acceptable *Products*:
 - .1 CertainTeed 'GlasRoc Diamondback Tile Backer'.
 - .2 CGC 'Durock Brand Glass-Mat Tile Backerboard'.
 - .3 Georgia-Pacific 'Dens-Shield Tile Backer'.

2.3 Attachment Materials

- .1 Screws; for gypsum board: bugle head, fine thread, self-tapping, Type W or S or S-12 point to suit framing type and metal gauge, with corrosion resistant finish to ASTM C1002-07/ASTM C954-11. Screw sizing:
 - .1 #6 x 25 mm (1") for single thickness board fastening.
 - .2 #6 x 32 mm (1-1/4") for single thickness 15.9 mm (5/8") board fastening.
 - .3 #7 x 41 mm (1 5/8") for double thickness board fastening.
- .2 Tie wire: 1.6 mm (0.063") diameter galvanized soft annealed steel wire.

Gypsum Board

2.4 Accessories

- .1 Accessories: to ASTM C1047-14a unless otherwise indicated, maximum length pieces per location. Flanges shall be free from dirt, grease, or other material that adversely affects the bond of joint treatment or decoration.
- .2 Casing trim; "L" or "LC" beads: Fillable edge trim, 0.55 mm (0.022") base thickness commercial grade sheet steel with zinc wiped coating to ASTM A653/A653M-13; perforated flanges.
 - .1 Acceptable *Products*:
 - .1 Bailey 'D200' and '4411'.
- .3 Partition Closures:
 - .1 Adjustable partition closure: pre-finished, pre-assembled, interlocking metal channels, sized and fitted to suit curtain wall framing and partition terminations, finished to match curtain wall framing, including gaskets with adhesive at each end.
 - .2 Basis of Design Product:
 - .1 Mull-it-over Products, Sound Barrier mullion trim cap system.
 - .3 STC: minimum 55.
 - .4 Profile: Classic.
 - .5 Factory cut to height as required.
 - .6 Aluminum Extrusions: Thickness: 0.125 inches.
 - .7 Sound Absorbing Foam:
 - .1 Resistant to smoke, flame, and microbial growth.
 - .2 Fungi Resistance: Zero rating per ASTM G 21.
 - .8 Compressible Foam: Between edge of extrusion and interior face of curtain wall glass. Minimum Thickness: 1/2 inch (12.7 mm) as required to accommodate mullion deflection.
 - .1 Color: Light gray.
 - .9 Finishes:
 - .1 Aluminum: Clear anodized finish in accordance with AA-M10 C22 A41 Class I (0.7 to 1.0 thick anodic coating) to match existing.

2.5 Miscellaneous Materials

- .1 Building paper: No. 15 asphalt impregnated building paper.
- .2 Neoprene foam; thermal separator: soft white neoprene foam tape, self-adhesive, 3 mm (1/8") thick (uncompressed).

2.6 Related Support Assemblies and Backer Plates

- .1 Metal support systems and backer plates at interior assemblies: in accordance with Section 09 22 00.

2.7 Joint Treatment Materials

- .1 General: Comply with ASTM C475/C475M-17.
- .2 Joint tape:

Gypsum Board

- .1 Interior paper faced gypsum boards: Paper.
- .2 Glass scrim interior gypsum board,; Alkali-resistant fibre mesh tape, minimum 50 mm (2") wide and as recommended by tile backer panel manufacturers.
- .3 Joint compound for interior gypsum board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - .1 Prefilling: Use setting-type compound as recommended by panel board manufacturer.
 - .2 Embedding and first coat: Use setting-type or taping compound as recommended by panel board and trim accessory manufacturers.
 - .3 Fill and finish coats: Use sanding type setting-type or taping compound as recommended by panel board manufacturer.
- .4 Skim coat: For final coat of Level 5 finish, use one of the following:
 - .1 Setting-type, sandable topping compound.
 - .2 Drying-type, all-purpose compound.
 - .3 High-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- .5 Joint compound for exterior applications:
- .6 Joint compound for tile backing panels:
 - .1 Tile backer board; coated glass scrim gypsum board: As recommended by backing panel manufacturer.

PART 3- EXECUTION

3.1 Installation

- .1 General: Comply with ASTM C840-13, GA 216-13, GA 600-12, and manufacturer's requirements, except as otherwise indicated. Do not bridge building expansion joints with support system. Frame both sides of joints with furring and other supports as indicated.
- .2 Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1.6 mm (1/16") open space between boards. Do not force into place.
- .3 Cover both faces of stud partition framing with gypsum board in concealed spaces (above ceiling, and the like) unless otherwise indicated, except in chase walls which are properly braced internally.
- .4 Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cut-outs.
- .5 Do not apply gypsum board in close proximity to hot pipes or heating ducts.
- .6 Install materials with the minimum number of joints. Tightly butt joints, without force, and neatly align them.
- .7 Frame openings on every side. Provide clearances with services.
- .8 Work shall include bulkheads over doors, frames, screens, and changes in ceiling levels, pipe space and as indicated.
- .9 Provide clearances between work of this section and structural elements to prevent transference of structural loads in accordance with Section 09 22 00.
- .10 Tolerances:

Gypsum Board

- .1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane in exposed surfaces, except at end joint between gypsum board panels.
- .2 Do not exceed 10 mm (3/8") from indicated location.
- .3 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.
- .4 Surface flatness shall not exceed 1.5 mm (1/16") within 305 mm (12") straight edge. For non-tapered-edge end joints between boards, measure flatness tolerance with end of straight end at centreline of joint.

3.2 Accessories

- .1 At external corners install corner trim secured to framing at 230 mm (9-1/16") on centre on both flanges with screw fasteners or clinch tool.
- .2 Secure casing trim at board edges where exposed to view, where board butts against other materials with no trim to conceal junction, at perimeter of ceiling surfaces at tops of partitions where they stop against continuous ceiling surfaces, and where indicated.
- .3 Erect accessories straight, plumb or level, rigid and at proper plane.
- .4 Use full length pieces.
- .5 Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners, free from rough edges. Secure in accordance with manufacturer's specifications unless otherwise required.
- .6 Installation tolerances:
 - .1 Alignment with board panels shall not exceed tolerances specified above.
 - .2 End joints shall be flush aligned to maximum offset of 0.5 mm (0.020").

3.3 Board Application - General

- .1 Before application of gypsum board commences, ensure that internal services have been installed, tested, and approved; that conduits, pipes, cables, and outlets are plugged, capped, or covered; and that fastenings and supports installed by others are in place.
- .2 Extend board into door, window, and other openings, reveals, behind fitments, and other applied items and on metal stud partitions to structure above unless indicated otherwise.
- .3 Apply board with long dimension perpendicular to supports, unless otherwise indicated.
- .4 Locate joints on opposite sides of partitions on different studs, and at least 305 mm (12") from opening jambs.
- .5 Install board to minimize joints, and align end joints to be the least objectionable (where they are unavoidable), according to the indicated lighting design. Locate joints in ceilings where least prominently discerned, and never line them up with opening edges.
- .6 Form smooth joints at ends and at field cut edges of board panels.
- .7 Fasten board to metal support members by metal gypsum board screws, 9.5 mm (0.374") minimum to, and 12.7 mm (1/2") maximum from, center of joints. Space screws:
 - .1 At typical board walls at 400 mm (16") on centre at edges and field unless otherwise required.
 - .2 At typical board ceilings at 305 mm (12") on centre at edges and field unless otherwise required.
- .8 Offset gypsum board joints 150 mm (6") minimum from corners of openings.

Gypsum Board

- .9 Gypsum panel product joints shall be located so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.

3.4 Interior Tile Backer Board Application

- .1 Install in accordance with manufacturer's written requirements.
- .2 Maximum fastener spacing:
 - .1 Walls: fasten at 150 mm (6") on centre.
 - .2 Ceilings: fasten at 150 mm (6") on centre.
 - .3 Maintain 6 mm (1/4") gap between board and tub base and fill with sealant as to comply with requirements of Section 09 31 00.
- .3 Section 09 31 00 to install tile setting material over tape installed by this section. Install mesh tape centred over tile backer board joints. Tape joints and angles.

3.5 Finishing

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

Gypsum Board

- .3 Apply first coat of compound over flanges of trim and accessories, and over exposed fastener heads and finish level with board surface.
- .4 Fastener heads and accessories shall be covered with 1 coat of joint compound.
- .4 Second coat (Level 3): After first coat treatment is dried, apply second coat of compound over tape and trim, feathering compound 50 mm (2") beyond edge of first coat.
 - .1 Fastener heads and accessories shall be covered with total of 2 separate coats of joint compound.
- .5 Third coat (Level 4):
 - .1 After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 50 mm (2") beyond edge of second coat.
 - .2 Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
 - .3 Finished joints will be accepted with a camber not greater than 1 mm (1/32") and shall be seamless, plumb, true and flush and with square, neat corners.
 - .4 Fastener heads and accessories shall be covered with total of 3 separate coats of joint compound.
 - .5 Where new partitions align with existing gypsum board, apply required amount of skim coats to make transition inconspicuous from a distance of 914 mm (36").
 - .6 Completed installation at interface between new and existing construction shall provide an inconspicuous joint.
- .6 Skim coat (Level 5):
 - .1 After the fourth coat has dried, apply skim coat of topping or all-purpose drying-type compound over exposed surfaces of gypsum board.
 - .2 After skim coat has dried, touch-up and sand to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
 - .3 Apply high build skim coat in accordance with manufacturer's written requirements.
- .3 Interior tile backer board: Prepare and finish joints in accordance with manufacturer's written requirements.
- .4 Joint compound:
 - .1 Apply finish coat of compound feathering 75 to 100 mm (3" to 4") beyond tape edges.
 - .2 Feather coats onto adjoining surfaces so that camber is maximum 0.79 mm (1/32").
- .5 Trim:
 - .1 Use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports, unless otherwise recommended by trim manufacturer.
 - .2 Install metal corner beads at external corners.
 - .3 Install metal casing bead trim whenever edge of gypsum base would otherwise be exposed or semi exposed, and where gypsum base terminates against dissimilar material.
 - .4 Erect beads plumb or level, with minimum joints.
- .6 Control joints:

Gypsum Board

- .1 Provide control joints set in board facing. Support control joints with studs or furring channels on both sides of joint.
- .2 Provide control joints in required locations; including interior gypsum board.
 - .1 Review control joint locations with *Consultant* prior to installation.
- .3 Install control joints where a partition, wall, or ceiling traverses a construction joint (expansion, seismic or building control element) in the building structure.
- .4 Install control joints where a wall or partition runs in an uninterrupted straight plane exceeding 9100 mm (30 linear feet).
- .5 Install control joints in interior ceilings:
 - .1 With perimeter relief:
 - .1 Linear dimensions between control joints shall not exceed 15000 mm (50 ft) and total area between control joints shall not exceed 230 m² (2500 ft²).
 - .2 Without perimeter relief:
 - .1 Linear dimensions between control joints shall not exceed 9100 mm (30 ft) and total area between control joints shall not exceed 84 m² (900 ft²).
- .6 Install control joints where ceiling framing members change direction.
- .7 Where a control joint occurs in an acoustical system, blocking shall be provided behind the control joint by using a backing material such as 16 mm (5/8") type X gypsum panel products, mineral fibre, or other tested equivalent.
- .8 Line up control joints with joints in other construction or with centre lines of mullions, columns, piers, or similar building elements, where accepted by *Consultant*.
- .9 Install control joints straight and true.
- .10 Ceiling height door frames may be used as control joints. Less than ceiling height frames shall have control joints extending to the ceiling from both corners. If control joints are not used, additional reinforcement is required at corners to distribute concentrated stresses.
- .11 Board joints shall be located so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.

3.6 Adjusting and Cleaning

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

END OF SECTION

Tiling

PART 1 - GENERAL

1.1 Summary

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

1.2 References

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

1.3 Administrative Requirements

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

1.4 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
 - .2 Submit manufacturer's installation requirements for *Products* proposed for use in the work of this section.
- .2 Samples:
 - .1 Submit 3 -full size samples of each type of tile specified.
 - .2 Submit 3 - 305 mm (12") long samples trim accessory.
- .3 Test and evaluation reports:
 - .1 Submit moisture, alkalinity, and mortar bond test results.

1.5 Closeout Submittals

- .1 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance requirements for inclusion in the operation and maintenance manuals.

Tiling

- .2 Maintenance materials:
 - .1 Provide minimum 2% of each type and colour of tile required for the *Work* for maintenance use.
 - .2 Maintenance material to be of same production run as installed material.

1.6 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Execute work of this section only by a *Subcontractor* who has adequate plant, equipment, and skilled workers to perform it expeditiously, and is known to have been responsible for similar satisfactory installations.
 - .2 Mock-ups:
 - .1 Grout mock-up: 1220 mm x 1220 mm (48" x 48") sample panels of each tile type and colour, texture, size, and pattern of tile and grout.
 - .2 Install each product and colour mock-up for acceptance by *Consultant*. Accepted mock-up shall form basis of standard of workmanship for remainder of work.
 - .3 Mock-up shall consist of floor/wall/base corner intersection, with 300 mm (12") of finish product on each face and control joints.

1.7 Field Conditions

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

1.8 Extended Warranty

- .1 Warrant work of this section for a period of 2 years.

PART 2- PRODUCTS

2.1 Performance/Design Requirements

- .1 ANSI - American Standard Specification for the Installation of Ceramic Tile.
- .2 Terrazzo, Tile and Marble Association of Canada ("TTMAC") Specification Guide 09 30 00 Tile Installation Manual TTMAC 2019-2021 Specification Guide 09 30 00, Tile Installation Manual.
- .3 Slip resistance; horizontal floors wet condition: DCOF in accordance with ANSI A137.1-2012.
 - .1 Performance value shall be not less than 0.42 for level interior applications, 0.60 for exterior applications and 0.65 for ramped floors and inclines.

2.2 General

- .1 Single source responsibility: In any given space, use mortar and grout from a single manufacturer.
 - .1 In locations requiring crack isolation membrane, mortar and grout shall be from the same manufacturer as crack isolation membrane.

Tiling

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

2.3 Tile Products

- .1 Porcelain tile: Refer to Finish Schedule.
 - .1 *Product*:
 - .1 TL-1:
 - .1 Ariostea 'Coll. Accademia - P612648 - Bellini Soft'
 - .1 Size: 60 x 120 x 10 mm thick
 - .2 Finish: Soft
 - .3 Shade: V117
 - .4 Provide special bullnose trim.
 - .2 Grout:
 - .1 Latex-Portland thin bed mortar cement grout.
 - .2 Colour: Colour to be selected by *Consultant*.
 - .3 Adhesive: Portland cement thin bed mortar.

2.4 Mortar Materials

- .1 Unless otherwise specified, select from the following thin-set mortar:
 - .1 Latex modified Portland cement thin bed mortar gauged:
 - .1 ANSI A118.4 (ANSI A108/A118/A136.1-2017) and ANSI A118.11 (ANSI A108/A118/A136.1-2017).
 - .2 White colour for translucent tile applications.
 - .3 Acceptable *Products*:
 - .1 Ardex 'X77 Microtec Fiber Reinforced Mortar' with Ardex 'E90 Mortar Admix'.
 - .2 Custom Building Products 'ProLite'.
 - .3 Flextile '51' mixed with Flextile '44'.
 - .4 Laticrete 'Laticrete 4237 Latex Thin Set Liquid' with 'Portland 211 Crete Filler Powder'.
 - .5 Mapei 'KERALASTIC' mixed with 'KERABOND'.
 - .6 Profix '6500' liquid latex mixed with '8500' thin set mortar.
 - .7 Promo Adhesives Inc. 'Pro Bond Plus' with 'Pro Bond Plus Additive'.
 - .8 TEC 'Superflex Ultra-Premium Thin Set'.
 - .2 Mortar for large format tiles meeting definition under paragraph 1.2.1.1:
 - .1 Enriched, modified, fast-set Portland cement medium bed mortar high-hydration, low residual moisture behind the tile formula.
 - .2 ANSI A118.4 (ANSI A108/A118/A136.1-2017) and ANSI A118.11 (ANSI A108/A118/A136.1-2017).

Tiling

- .3 Substrate primer: in accordance with manufacturer's installation requirements.
- .4 White colour for translucent tile applications and light coloured stones.
- .5 Acceptable *Products*:
 - .1 Ardex 'S 28 Microtec Rapid Hardening and Rapid Drying Semi-Pourable Natural Stone Floor Tile'.
 - .2 Custom Building Products: 'MegaLite'.
 - .3 Flextile '58XT'.
 - .4 Mapei 'Granirapid'.
 - .5 Laticrete '4-XLT Rapid'.
 - .6 Profix 'Flex GT-30'.
 - .7 Profix 'Optiflex' Full-Contact Mortar.
 - .8 Promo Adhesives Inc. 'Pro Quick SF' with 'Pro Quick Plus Additive'.
 - .9 TEC 'Fast Set Ultimate Large Tile Mortar'.
 - .10 TEC 'Fast Set 3N1 Performance Mortar'.
- .2 Mortar beds, levelling coats:
 - .1 Materials:
 - .1 Water: clean and free of chemicals detrimental to mortar and grout mixes.
 - .2 Sand: to ASTM C144-18, passing 16 mesh.
 - .3 Cement: to CSA A3002-13, Type U.
 - .4 Latex: Formulated for use with Portland cement mortars.
 - .5 Cleavage membrane: 0.10 mm (4 mil) thick polyethylene film to CAN/CGSB 51.34-M86.
 - .6 Metal lath: Galvanized type, 1.4 kg/m³ to ASTM C847-18.
 - .7 Reinforcing mesh: 51 mm x 51 mm (2" x 2") mesh size, fabricated from 1.6 mm (0.06") thick galvanized steel wire; welded fabric design.
 - .2 Mixes:
 - .1 Scratch coat (by volume): 1 part Portland cement, 4 parts sand, and water or latex where required by TTMAC detail. Premixed mortar may be used per manufacturer's requirements. Adjust liquid volume may be adjusted depending on water content of sand to obtain consistency and workability.
 - .2 Slurry bond coat: Mix Portland cement and water to a creamy paste consistency. Include latex additive where required by TTMAC detail.
 - .3 Mortar bed for walls (by volume): 1 part Portland cement, 4 parts sand, and water or latex where required by TTMAC detail. Premixed mortar may be used per manufacturer's requirements. Adjust liquid volume may be adjusted depending on water content of sand to obtain consistency and workability.
 - .4 Levelling coat (by volume): 1 part Portland cement, 4 parts sand, and water or latex where required by TTMAC detail. Premixed mortar may be used per manufacturer's requirements. Adjust liquid volume may be adjusted depending on water content of sand to obtain consistency and workability.

Tiling

- .5 Mortar bed for floors (by performance): 1 part Portland cement, 4 parts sand, and water or latex where required by TTMAC detail. Premixed mortar may be used per manufacturer's requirements. Adjust liquid volume may be adjusted depending on water content of sand to obtain consistency and workability that will allow compaction during tamping of the mortar bed, and achieve minimum compressive strength of 15 MPa after 28 days.

2.5 Grout Materials

- .1 High performance polymer-modified grout:
 - .1 Weather, frost and shock resistant.
 - .2 ANSI A118.7 (ANSI A108/A118/A136.1-2017).
 - .3 Acceptable *Products*:
 - .1 Custom Building Products: 'Prism Ultimate Performance Grout'.
 - .2 Laticrete 'PermaColor Grout'.
 - .3 Mapei 'Ultracolor Plus'.
 - .4 Promo Adhesives Inc. 'Pro Topgrout'.
 - .5 TEC 'Power Grout'.
 - .2 Grout colours to later selection by *Consultant* from manufacturer's full range.
 - .3 Grout sealer: as recommended by grout manufacturer.

2.6 Crack Isolation Membrane

- .1 Crack isolation membrane shall be thin, flexible, cold applied, load bearing, ANSI A118.12 (ANSI A108/A118/A136.1-2017) with Extra Heavy Service rating tested to ASTM C627-18 on concrete substrates. Materials to be non-toxic, non-flammable, and non-hazardous during storage, mixing, application and when cured.
 - .1 Accessories:
 - .1 Reinforcing fabric to be non-woven rot-proof specifically intended for crack isolation membrane as recommended by crack isolation membrane manufacturer.
 - .2 Mortar; for setting tile: Compatible product as recommended by crack isolation membrane manufacturer.
 - .2 Acceptable *Products*:
 - .1 Ardex '8+9 Waterproofing and Crack Isolation Compound'.
 - .2 Custom Building Products 'Crack Buster Pro'.
 - .3 Flextile 1000 Flexilastic'.
 - .4 Flextile 'WP980 Waterproof & Crack Isolation Membrane'.
 - .5 Laticrete 'Blue 92 Anti-Fracture Membrane'.
 - .6 Mapei 'Mapeguard 2'.
 - .7 Profix 'Imper'.
 - .8 Promo Adhesives Inc. 'Pro CBM Membrane'.
 - .9 TEC 'Hydraflex Waterproofing Crack Isolation Membrane'.

Tiling

2.7 Accessories and Related Materials

- .1 Trim accessories:
 - .1 Access door trim: "Schluter-Rema" consisting of four aluminum brackets with molded casings containing magnets as manufactured by Schluter Systems.
 - .2 Edge/corner trim: Schluter-DECO-DE clear satin anodized aluminum.
 - .3 Finishing and edge protection; walls:
 - .1 Schluter Systems 'JOLLY'.
 - .2 Schluter Systems 'DECO-DE'.
 - .4 Finishing and edge protection; floors:
 - .1 Schluter Systems 'SCHIENE'.
 - .2 Schluter Systems 'RENO-TK'.
 - .3 Schluter Systems 'RENO-U'.
 - .4 Schluter Systems 'DECO'.
- .2 Joint sealants: mildew resistant sealant in accordance with Section 07 92 00.

PART 3- EXECUTION

3.1 Examination

- .1 Ensure compatibility of *Products* supplied under this section, and which bear contact with substrate.
- .2 Before work of this section commences, examine the areas to be covered and report any flaw or adverse conditions in writing to the *Contractor* and the *Consultant*. Do not proceed with work until surfaces and conditions comply with the requirements indicated in the manufacturer's requirements and in ANSI A108.5 (ANSI A108/A118/A136.1-2017) specification.
- .3 Miscalibrated tiles, tiles with chipped corners, tiles with holes, will not be accepted for installation.
- .4 Inspect tiles for colour variation. Tiles presenting noticeable variations shall be carefully selected, set aside and used in areas where they fit in the pattern homogeneously. Provide for appropriate lighting equipment in addition to existing lighting in the immediate area where the installation is being performed so that any shade differences which are normally very slight can be identified easily.

3.2 Preparation

- .1 Completely remove contaminants and deleterious substances and debris which may prevent, reduce, and affect adhesion or performance or may act as bond breaker.
- .2 Wire brush steel substrates to remove deleterious substances and rust, to promote full adhesion to steel.
- .3 Roughen surfaces with previously painted glossy finishes by sandpaper or other abrasive medium, and completely remove finishes which are not compatible with products specified under this section.
- .4 Prime gypsum, wood or porous concrete with primer, brush or roller applied at full strength in accordance with mortar manufacturer's recommendations.
- .5 Floor surfaces:

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- .1 Prepare concrete to receive crack isolation membrane in accordance with International Concrete Repair Institute (ICRI) designation CSP-2.
- .2 Concrete shall be minimum of 90 days old.
- .3 At door opening locations where finished flooring is adjacent to weather-stripping or automatic door bottoms provide trowel-applied levelling compound to provide full contact between finished flooring and weather-stripping or automatic door bottoms. Taper trowel-applied levelling compound to transition with adjacent flooring substrate to provide smooth and seamless transition at maximum slope of 3:1000 (height to distance) ratio.
- .6 Concrete shall be dry with maximum allowable moisture in accordance with product manufacturer's written requirements for products to be installed directly over concrete.
- .7 Alkalinity, moisture, and adhesion testing:
 - .1 Perform moisture and alkalinity tests and mortar bond test.
 - .2 Where concrete substrate exhibits higher than permitted moisture and alkalinity levels, *Provide* water vapour reduction system and repeat moisture and alkalinity tests and mortar bond tests.
 - .3 Proceed with installation only after substrates pass testing. Document tests performed and submit in writing to *Consultant*.

3.3 Mixing

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

3.4 Crack Isolation Membrane Installation

- .1 Install crack isolation membrane system to comply with manufacturer's written requirements.
- .2 Install crack isolation membrane to tile flooring assemblies utilizing large format tile and as indicated.
- .3 Install crack isolation membrane to substrates for tile flooring installations located on suspended structural floor assemblies. Treat substrate with full coverage of crack isolation membrane and reinforcement in accordance with crack isolation membrane manufacturer's installation requirements.

3.5 Installation - General

- .1 Install *Products* in accordance with manufacturer's specifications and as indicated herein, in accordance with TTMAC Specification Guide 09 30 00 Tile Installation Manual TTMAC 2019-2021 Specification Guide 09 30 00, Tile Installation Manual, and in accordance with ANSI A108.5 (ANSI A108/A118/A136.1-2017) except where specified otherwise.

3.6 Thin-Set Method

- .1 Make joints even, straight, plumb and of uniform width.
- .2 Provide mortar beds and levelling coats in accordance with TTMAC details.
- .3 *Provide* edge protection at tile edges and corners, unless otherwise indicated, using maximum length pieces.
- .4 *Provide* edge protection and transition strips at tile transitions, unless otherwise indicated, using maximum length pieces.
- .5 Review locations of tile accessories with *Consultant* prior to setting tile and comply with directions of *Consultant*.

Tiling

- .6 Lap tile and seal with sealant at inside corners and bath/shower fixtures. Caulk around pipes and openings made in tile with sealant.
- .7 Apply sealant at interface with frames at openings. Apply sealant in accordance with Section 07 92 00 and manufacturer's requirements.
 - .1 Sealant colour to later selection by *Consultant*.
- .8 Install flooring to entire area indicated or scheduled. Unless otherwise indicated, include coverplates occurring within finished floor areas. Maintain overall uniform continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Do not install flooring to floor drains occurring within finished floor areas.

3.7 Tile Setting

- .1 Lay out tile work as indicated on drawings, and where lay-out is not indicated, lay-out tiles so tiles less than 1/2 the least dimension do not occur and with minimum amount of cutting.
- .2 Using a damp towel, wipe off the back side of tile to remove any dust or other residue that may be left over from the manufacturing process.
- .3 Place as much tile as possible in one operation before setting bed reaches initial set. Clean back and remove bed when it has set before tile is laid.
- .4 Prime materials and by methods specified by manufacturer of bond coat.
- .5 Except where tiles have setting tabs, and except for expansion, control and isolation joints, maintain joint widths as selected by *Consultant*.
- .6 Back up tile coves, curbs and other shaped pieces solid with mortar. Rigidly set, reinforce or otherwise make firm and secure such pieces.
- .7 Beat tiles in thoroughly and sufficiently to cause mortar ribs or notches to come together into a continuous void free bed and allow the mortar to flow up partially into the joint space to maximum of 1/3 the thickness of the tile. Sound floor tiles by tapping and reset all tiles with voids in setting bed.
- .8 Tile shall contact setting materials for minimum of 95% coverage unless otherwise indicated.
- .9 Obtain 100% mortar coverage with applicable requirements for back buttering of tile in referenced TTMAC and ANSI A108/A118/A136.1-2017 series of tile installation standards for the following:
 - .1 Tile in wet areas.
 - .2 Tile having any dimension 300 mm (12") or larger in any direction.
 - .3 Tile with raised or textured backs.
 - .4 Tile installation rated for Heavy or Extra Heavy Duty.
 - .5 Porcelain tiles with more than 20% of the tile backs covered with firing release dust back buttered so that 100% of the back is covered with mortar rated for C627, Extra Heavy Duty rating.
- .10 Remove any excess setting material from the joint area so that 2/3 of the depth of the tile is available for grouting.
- .11 Remove smudges or smears of setting material from the tile surface with a damp sponge or cloth immediately after final adjustment and beat-in while the mortar is fresh.
- .12 Do necessary cutting and drilling of fixtures, fittings, and built-in or penetrating units without marring the tile. Replace all cracked or damaged tile.

Tiling

- .13 Extend tile into recesses at windows, doors, or other openings.
- .14 Extend tiles 100 mm (4") behind mirrors, and fully behind cabinets, cupboards and other fixed objects at walls.
- .15 Cut tiles to conform to irregularities in wall lines and vertical planes along outer edges. Smooth cut edges with carborundum block or by other means to provide clean straight edge.
- .16 Install tiles to provide even distribution of shading, colour, and characteristics.

3.8 Control Joints

- .1 Install control joints and expansion joints in tile work in accordance with TTMAC Detail 301MJ-2019-2021 in floors and walls and at perimeters of floors, around columns and where tile abuts other hard materials and as indicated.
 - .1 Review locations with *Consultant* prior to setting tile and comply with instruction given by *Consultant*.
- .2 Carry substrate control and movements joints through to tile work.
- .3 Cut tiles on both sides along the edges of control or expansion joints.
- .4 Sealant control joints: Raking out joints to full depth of tile and cleaning joints for application of sealant in accordance with Section 07 92 00.

3.9 Trim Accessories Installation.

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

3.10 Grouting

- .1 Install grout to comply with ANSI A118.4 (ANSI A108/A118/A136.1-2017) unless otherwise specified and in accordance with manufacturer's written requirements.
- .2 Allow tile installation to cure a minimum of 24 hours prior to grouting.
- .3 Grout joints shall be free of dirt, debris, water or tile spacers and face of tiles are clean.
- .4 Apply a coat of grout release and achieve 100% surface covered of tile following grout release manufacturer's written requirements.
- .5 Pack joints full and free of voids/pits.
- .6 Allow grout joints to become firm. Inspect joint for pinholes/voids and repair them with freshly mixed grout. Within 24 hours, check for remaining haze and remove it with warm soapy water and a nylon scrubbing pad, using a circular motion, to lightly scrub surfaces and dissolve haze/film.
- .7 Grout joint width to be 4.7 mm (3/16") unless otherwise indicated; except at mosaic type tiles on paper or mesh backed sheets.
- .8 Use caution when using sanded grouts to prevent scratching of tile or other material surfaces.
- .9 Do not cover, bridge or fill any expansion joints in tile with grout.

Tiling

3.11 Tile Installation Tolerances

- .1 Maximum allowable lippage:
 - .1 Tile up to 152 mm x 152 mm (6" x 6") in size: 1 mm (0.040").
 - .2 Tile greater than 152 mm x 152 mm (6" x 6") in size: 2 mm (0.080").
- .2 Finish planes shall be straight and plumb to within 6 mm in 3 m (1/4" in 10 feet).

3.12 Adjusting and Cleaning

- .1 Clean installed tile surfaces after grouting has cured.
- .2 Re-point joints after cleaning to eliminate imperfections. Avoid scratching tile surfaces.

3.13 Protection

- .1 Protect work of this section against damage by work of other sections for a minimum of 72 hours after application of grouting by prohibiting passage of traffic over tile. Do not immerse in water and protect tilework from freezing for at least 28 days after installation.
- .2 Protect floors from impact and vibration for a minimum of 48 hours after installation.
- .3 Install floor protection in areas where other work, repairs and installation of equipment, and foot traffic will occur.
- .4 Where latex or polymer additives are used in mortar materials, materials shall be cured a minimum of 14 days before exposure to moisture and before water immersion and longer as included in mortar manufacturer's written requirements.

END OF SECTION

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Acoustical tile ceiling systems.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Cooperate with mechanical and electrical *Subcontractors*.
 - .2 Coordinate layout and installation of acoustic ceiling units and suspension systems components with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, partition system, fire suppression system components and other work required to be incorporated in or coordinated with the ceiling system.
- .2 Conduct a pre-installation meeting.

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .2 Shop drawings:
 - .1 Submit manufacturer's standard details.
 - .2 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines, and acoustical unit support at ceiling fixture.
 - .3 Submit reflected ceiling plans for special grid patterns as indicated.
- .3 Samples:
 - .1 Submit sample of each component of ceiling system. Samples shall fully represent materials to be supplied in colour, texture, finish and construction.
 - .2 Submit samples, load test data and design tables for each type of insert to be used in the *Work* for hanger supports.
- .4 Certificates:
 - .1 Submit certificate of compliance stating that the suspension system provided, including materials and installation, comply with the requirements of the *Contract Documents*.

1.4 Closeout Submittals

- .1 Maintenance data:
 - .1 Submit maintenance and cleaning instructions for acoustical ceiling systems for incorporation into the maintenance manuals.
- .2 Maintenance materials:
 - .1 Deliver for maintenance use, 2% of each type and colour of suspension components and acoustical tiles used in the *Work*.

Acoustical Tile Ceiling Systems

- .2 Pack panels in suitable containers, clearly dated and identified as to type and location of installation in the *Work*, and store where directed by *Owner*.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 *Provide* work of this section, executed by competent installers with similar experience in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
 - .2 Aspects of the work of this section are required to be prepared by a professional engineer. Refer to Section 01 33 00 for specific details and requirements in this regard.

1.6 Delivery, Storage, and Handling

- .1 Ship exposed members and mouldings in rigid crates to avoid damage. Bent or deformed material shall be rejected. Baked enamelled members shall be suitably wrapped and protected against damage.
- .2 Deliver acoustical ceiling units to the *Place of the Work* in original, unopened packages and store in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- .3 Before installing acoustical ceiling units, permit them to reach room temperature and stabilized moisture content.
- .4 Handle acoustical ceiling units carefully to avoid chipping edges or damaging units.

1.7 Field Conditions

- .1 Commence installation after building is enclosed with windows and exterior doors in place and glazed, and roof watertight.
- .2 Interior temperature of building to range from 15°C to 30°C and relative humidity of not more than 70% before and during installation. Maintain uniform temperatures for 72 hours prior to commencement of the work of this section and maintain temperature until completion of the work of this section.

1.8 Extended Warranty

- .1 Warrant work of this section for a period of 2 years.

PART 2- PRODUCTS

2.1 Performance/Design Requirements

- .1 Contractors (AWCC), 2012 Wall and Ceiling Specifications Standard Manual.
- .2 Design suspension systems for a maximum mid-span deflection not exceeding L/360 in accordance with ASTM C635/C635M-17 deflection test.
- .3 Design suspension system to support safely, and without distortion, the superimposed loads of:
 - .1 Air supply diffusers and return grilles.
 - .2 Lighting fixtures.

Acoustical Tile Ceiling Systems

2.2 General

- .1 Single source responsibility: Obtain each type of acoustical ceiling unit and suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the *Work*. Products installed as part of the work of this section shall be from same production run.

2.3 Acoustical Tiles

- .1 Lay-in acoustical tiles (C1):
 - .1 Colour: White.
 - .2 24" x 48" x 5/8".
 - .3 CAC: 35.
 - .4 NRC: Minimum 0.50.
 - .5 Grid: 15/16" Prelude XL (HD), White colour.
 - .6 Acceptable *Products*:
 - .1 Armstrong 'Dune Square Lay-in 1851M'
 - .2 Armstrong Cortega Lay-in 823'
 - .3 No Substitution.

2.4 Suspension Systems

- .1 Hanger anchorage devices: Screws, clips, bolts, concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3 x calculated load supported except size direct pull-out concrete inserts for 5 x calculated loads.
- .2 Concrete hanger anchors; post installed: Steel eye bolts and nuts to suit ceiling hangers with capability to sustain, without failure, a load equal to 4 times that imposed by ceiling construction, as determined by testing per ASTM E488/E488M-18, conducted by a qualified independent testing laboratory.
 - .1 Dynabolt Sleeve Anchor 'TW-1614' or Readi-Tie-Drive 'TD4-112' tie wire anchor by ITW Ramset/Red Head.
 - .2 Kwik-Bolt III 'HHDC A 1/4' tie wire anchor by Hilti Corporation.
 - .3 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.
- .3 Hangers and tie wire: Galvanized wire, recommended by manufacturer of suspension system, minimum 2.66 mm (0.1") (12 gauge).
- .4 Suspension system accessories:
 - .1 Splices, clips, and perimeter moulding, of manufacturer's standard type to suit the applicable conditions unless special conditions and access area are shown or specified.
 - .2 Angle wall mouldings; hemmed with prefinished exposed flanges, Colour: White:
 - .1 For 24 mm (15/16") grid applications; angle moulding with exposed bottom flange of 22 mm (7/8").
 - .1 Armstrong '7803'.

Acoustical Tile Ceiling Systems

- .2 CertainTeed 'WA15-15'.
- .3 CGC 'M7'.
- .2 For 14 mm (9/16") grid applications; angle moulding with exposed bottom flange of 24 mm (15/16").
 - .1 Armstrong '7804'.
 - .2 CertainTeed 'Wall Angle WA15-9'.
 - .3 CGC 'M9'.
- .5 Wet environment grade suspension system:
 - .1 Interlocking tee system designed to support panels in patterns indicated, consisting of main tees and cross tees. System shall be complete with galvanized double-webbed steel body and aluminum face with stainless steel clips. The system shall provide lock joint intersections of cross and main tees.
 - .2 Acceptable *Products*:
 - .1 Armstrong 'Prelude XL 15/16" Exposed Tee System for Exterior Applications'.
 - .2 CertainTeed 15/16" Classic Environmental Stab'.
 - .3 CGC 'ZCLA'.

2.5 Metal Finish

- .1 Metal exposed in finished work shall have a pre-coated baked enamel finish in non-yellowing colour. Submit paint formulation of grid system to lighting fixture, speaker grille, sprinkler and diffuser manufacturers to ensure consistency of colour, sheen and texture of all exposed metal components in the ceiling assemblies.
 - .1 Colour: Flat white.

PART 3- EXECUTION

3.1 Installation - General

- .1 Install ceiling panels and metal suspension system in accordance with manufacturer's directions. Where manufacturer's directions are at variance with *Contract Documents*, notify *Consultant* before proceeding with installation.
- .2 Do not commence installation until all work above suspended ceiling has been completed, inspected and accepted.

3.2 Installation - Suspension System

- .1 Install suspension system rigid, secure, square, level and plumb, framed and erected to maintain dimensions and contours indicated, and in accordance with ASTM C636/C636M-13, CISCA installation standards and any other applicable national or local code requirements. Make allowance for thermal and structural movement.
- .2 Install suspension system rigid, secure, square, level and plumb, framed and erected to maintain dimensions and contours indicated, and in accordance with ASTM C636/C636M-13, ASTM E580/E580M-17, CISCA installation standards, and any other applicable national or local code requirements. Make allowance for thermal and structural movement.
 - .1 Install acoustical ceiling suspension system to resist seismic disturbance in accordance with ASTM E580/E580M-17.

Acoustical Tile Ceiling Systems

- .3 Attach hangers to structure with inserts and hanger supports. Do not use powder activated fasteners.
- .4 Support hangers for suspended ceiling grid independent of walls, columns, pipes and ducts.
- .5 Space hangers for ceilings at maximum 1220 mm (48") on centre in both directions. Provide additional hangers as required to comply with manufacturer's written installation requirements.
- .6 Locate hangers at not more than 150 mm (6") from ends of main tee members.
- .7 Install exposed tee members to pattern indicated. Securely attach hangers to main tee members.
- .8 Exposed tees shall be as long as possible to minimize joints. Make joints square, tight, flush and reinforce with splines. Distribute joints to prevent clustering in one area.
- .9 Space tee bars to suit ceiling panels and as detailed, and to accommodate lighting fixtures, diffusers and return grilles.
- .10 Cooperate in the installation of ceiling systems, making adjustments where required to ensure that the lighting fixtures, supply diffusers, exhaust grilles and other built-in items properly fit into ceiling module and finish flush with rest of ceiling.
- .11 Restrict creep inside module panels so that in all cases strips are centred on module lines.
- .12 Install edge moulding as detailed where ceiling abuts vertical surfaces. Lap corners, use maximum lengths to minimize joints. Make joints square, tight and flush.
 - .1 Screw attach mouldings to substrates at intervals not more than 400 mm (16") on centre and not more than 210 mm (8") from ends, levelling with suspension system. Lap corners accurately and connect securely.

3.3 Installation - Tiles

- .1 Take precautions during installation to ensure tile edges are not chipped or otherwise damaged.
- .2 Minimize field cutting. Rectify cut tile edges of tile to match factory cut edge profile and colour.
- .3 Install acoustical tiles to form horizontal and level ceiling with all parts flush and joints butted tightly to hairline appearance.
- .4 Distribute variations in colour and texture of panels to obtain a uniform appearance.

3.4 Installation - Tolerances

- .1 Allowable tolerances: to ASTM C636/C636M-13.
- .2 Install suspension systems level to tolerance of 1:1200.
- .3 Install edge mouldings level to tolerance of 3 mm in 3660 mm (1/8" in 12'-0").

3.5 Field Quality Control

- .1 Conduct quality control:
 - .1 Field tests and inspections:
 - .1 Independent inspection and testing company shall perform random load tests for ceiling anchor installation.

3.6 Adjusting and Cleaning

- .1 Replace uneven, defective or damaged materials and finishes, eliminate waves, remove soiled or stained areas.

Acoustical Tile Ceiling Systems

- .2 Clean dirty and discoloured surfaces of acoustical units and suspension system according to manufacturer's recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Resilient base.
 - .2 Resilient floor transition trims.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting.

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .2 Samples:
 - .1 Samples for verification: Submit 3 samples of the following:
 - .1 305 mm (12") long samples of each colour and type of base material. Include sample of outside corner of base.
 - .2 100 mm (4") long samples of each colour and type of floor transition trims.
- .3 Manufacturer's instructions:
 - .1 Submit manufacturer's installation instructions for *Products* proposed for use in the work of this section.

1.4 Closeout Submittals

- .1 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .2 Maintenance materials:
 - .1 Provide minimum 2% of each colour, pattern and type of resilient base required for this project.
 - .2 Maintenance materials to be same production run as installed materials.
 - .3 Suitably package for protection and storage, each identified with name of manufacturer and material.
 - .4 Tag and store where directed by *Owner*.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 *Provide* work of this section, executed by competent installers with similar experience in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

Resilient Base and Accessories

1.6 Field Conditions

- .1 Ambient conditions:
 - .1 Install materials of this section only when surfaces and air temperatures have been maintained between 21°C (70°F) and 29.4°C (85°F) for 7 days preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C (55°F) after above period.
 - .2 Ensure that adequate ventilation is provided during installation and curing of materials of this section.
 - .3 Applications exposed to intense or direct sunlight, protect *Products* during the conditioning, installation, and adhesive curing periods, by covering the light source.
 - .4 Allow coiled material to lay flat for at least 24 hours at 18°C prior to installation, and maintain this temperature during installation.

1.7 Extended Warranty

- .1 Warrant work of this section for a period of 2 years.

PART 2 - PRODUCTS

2.1 General

- .1 Single source responsibility: Obtain each type of resilient *Product* from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the *Work*. Products installed as part of the work of this section shall be from same production run.

2.2 Resilient Base

- .1 Rubber base types:
 - .1 Manufactured from thermoplastic rubber formulation meeting ASTM F1861-16, Type TP, Group 1 (Solid).
 - .2 Basis of Design Manufacturer and Product:
 - .1 Tarkett, Traditional Vinyl Wall Base, Type TV, 4" toed.
 - .2 Colour:
 - .1 Classroom: Black
 - .2 A millwork location: to later selection by *Consultant* from manufacturer's full range.

2.3 Accessories

- .1 Block wall filler: Filler type as recommended by resilient base manufacturer to suit substrate and compatible with materials.
- .2 Primers and adhesives: Types as recommended by resilient product manufacturer compatible with materials and to suit substrate types.

PART 3- EXECUTION

3.1 Examination

- .1 Ensure that field conditions have been provided as requested and specified.

Resilient Base and Accessories

- .2 Substrates shall be firm, structurally sound, sufficiently porous, and dry.
- .3 Examine substrate to ensure clean lines, correct level and freedom from cracks, ridges, dusting, scaling and carbonation.
- .4 Examine substrates in advance of application of products to ensure that substrates are protected against entry of water and moisture.
- .5 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- .6 Failure to call attention to defects or imperfections will be construed as acceptance and approval of the substrate. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.
- .7 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

3.2 Preparation

- .1 Substrates shall be free of deleterious material that may inhibit bond strength or act as a bond breaker. Remove such contaminants and deleterious material using mechanical methods recommended by manufacturer. Do not use chemical abatement methods.
- .2 Fill gaps, voids, and cracks, and remove ridges, or other defects which will ghost or telegraph through finished product installation.
- .3 Expansion joints, isolation joints, and other movement joints in substrates shall not be filled with patching or levelling compound.
- .4 Sweep and vacuum clean substrates minimum 24 hours prior to alkalinity, moisture, and adhesion testing. Do not use sweeping compounds.
- .5 Notify *Consultant* of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.
- .6 Do not install products until they are same temperature as space where they are to be installed.
- .7 Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. Do not use sweeping compounds.
- .8 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials.
- .9 Spray paints, permanent markers and other indelible ink markers shall not be used to write on the back of the resilient material or used to mark the substrate as they could bleed through and permanently stain the resilient material. If such contaminants are present on the substrate they shall be mechanically removed prior to the installation of the resilient material.

3.3 Installation of Resilient Base

- .1 Spread adhesive to ribbed surface (back) of wall base with a 3 mm (1/8") square-notched trowel; allow slight set-up, then bring base into contact with substrate. Ensure full adhesion of base to substrate. Adhesive should cover 80% of back surface. Leave a 6 mm (1/4") uncovered space at the top of the wall base to prevent the adhesive from oozing onto the wall above the base when installed.
- .2 Position wall base on wall surface and roll with hand roller. Always roll back to starting point to prevent stretching the wall base.
- .3 Set base to ensure installation over finished flooring material is free of gaps.

Resilient Base and Accessories

- .4 Install base in longest lengths possible, minimum 2440 mm (8'). Adhere toe of base to substrate, and ensure edge of toe is straight.
- .5 Scribe and fit to door frames and other obstructions.
- .6 Joints shall be tightly fitted, straight and vertical, and not less than 610 mm (24") from corners.
- .7 *Provide* joints in base over substrate control joints.

3.4 Installation Tolerances

- .1 Resilient base: Install straight and level to variation of 3 mm (1/8") over 3 m (10'-0").
- .2 Transition trim: Install straight to variation of 3 mm (1/8") over 3 m (10'-0").

3.5 Field Quality Control

- .1 Conduct quality control.
 - .1 Field tests and inspections:
 - .1 Moisture and alkalinity:
 - .1 Test for moisture and alkalinity in accordance with product manufacturer's written requirements.
 - .2 Adhesion bond test:
 - .1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.
 - .2 Adhesions tests shall be completed in accordance with product manufacture's written requirements.

3.6 Adjusting and Cleaning

- .1 Remove adhesive from surfaces as work progresses in manner described by manufacturer.
- .2 Thoroughly clean surfaces in accordance with manufacturer's written requirements.

END OF SECTION

Resilient Sheet Flooring

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Resilient sheet flooring.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Show sheet flooring roll and width layout as related to *Consultant's* floor pattern including borders and accents including where flooring materials meet other floor materials.
 - .2 Show locations of seams, floor drains, floor plates, and where flooring meets other flooring.
- .4 Samples:
 - .1 Samples for verification:
 - .1 Submit sample of resilient sheet flooring, minimum 150 mm (6") x 150 mm (6") of each different colour and pattern of resilient sheet flooring.
 - .2 Submit sample of heat-welding bead, minimum 150 mm (6") length of each colour.
 - .3 Submit seam samples for each resilient sheet flooring product and colour with heat-welded seam. Sample shall be a minimum of 150 mm (6") x 254 mm (10") and shall be adhered to a rigid backing material with the seam running lengthwise and in the center of the sample.
 - .4 Submit sample of fillet support at integral site formed flash cove bases,
- .5 Test and evaluation reports:
 - .1 Submit moisture, alkalinity, and adhesive bond test results.

1.4 Closeout Submittals

- .1 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .2 Maintenance materials:
 - .1 Submit 2% of each colour in full running length, pattern and type flooring material required for this project for maintenance use.
 - .2 Maintenance materials to be same production run as installed materials.

Resilient Sheet Flooring

- .3 Suitably package for protection and storage, each identified with name of manufacturer and flooring material.
- .4 Tag and store where directed by *Owner*.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 *Provide* work of this section, executed by competent installers in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
- .2 Mock-ups:
 - .1 Prior to commencing flooring installation for this section, prepare full room mock-up (room size at least 10 m² (100 ft²) in area) for acceptance by the *Consultant*.
 - .2 Mock-up shall include flooring showing edge treatment and relationships to adjoining surfaces.
 - .3 Location of installation shall be determined by *Consultant*.
 - .4 Do not proceed with flooring specified in this section until mock-up has been accepted by *Contractor* and *Consultant*.

1.6 Delivery, Storage, and Handling

- .1 Package flooring materials and identify contents of each package.
- .2 Store materials for a minimum of 24 hours immediately before installation to comply with temperatures specified under Field Conditions.
- .3 Store flooring rolls on end.

1.7 Field Conditions

- .1 Ambient conditions:
 - .1 Install materials of this section only when surfaces and air temperatures have been maintained between 18.4°C (65°F) and 29.4°C (85°F) for 48 hours preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C (55°F) after above period. Relative humidity shall be 50 +/- 10%.
 - .2 Ensure that adequate ventilation is provided during installation and curing of materials of this section.
 - .3 In areas that are exposed to intense or direct sunlight, *Products* shall be protected during the conditioning, installation, and adhesive curing periods, by covering the light source.
 - .4 Allow products to acclimatize in installation area for a minimum 24 hour prior to installation.

1.8 Extended Warranty

- .1 Warrant work of this section for a period of 2 years.
- .2 Repair or replace flooring areas that fail within the specified warranty period. Failures shall include, but are not limited to, staining or discolouration of flooring due to slab markings, delamination of flooring from substrate, and welded seams which separate.

Resilient Sheet Flooring

PART 2 - PRODUCTS

2.1 General

- .1 Single source responsibility: Obtain each product from a single source with resources to provide products of consistent quality in appearance and physical properties, same production run. Products installed as part of the work of this section shall be from same production run.

2.2 Resilient Sheet Flooring

- .1 Resilient Sheet Flooring (RSF)
 - .1 Acceptable Product, Colour:
 - .2 Tarkett iQ Optima sheet flooring, no alternates accepted.
 - .1 Color To later selection by Consultant from manufacturer's standard selection.

2.3 Miscellaneous Materials

- .1 Seam construction:
 - .1 Hot welded joints, provide welding rod matched to floor pattern/colour selected.
 - .2 Colours: To later selected by *Consultant* from full colour range.
- .2 Primer/adhesives:
 - .1 Types designed for wet areas as recommended by resilient flooring manufacturer compatible with materials and to suit substrate types and to comply with warranty requirements.
- .3 Patching and levelling compound:
 - .1 Trowel applied Portland cement based, moisture, mildew, and alkali-resistant.
 - .2 Minimum compressive strength after 28 days shall be minimum 3,500 psi when tested in accordance with ASTM C109/C109M-20a or ASTM C472.
 - .3 Gypsum based compounds are not acceptable.
 - .4 Acceptable manufacturers:
 - .1 Ardex.
 - .2 Mapei.
 - .3 Substitutions: in accordance with Section 01 25 00.
 - .5 Acceptable *Product*: type as recommended by flooring manufacturer.
- .4 Cleaning solution:
 - .1 Acceptable *Products*: type as recommended by flooring manufacturer.
- .5 Floor transition strips:
 - .1 Resilient transition trims:
 - .1 Tapered type as manufactured by Johnsonite or Finercraft to suit site condition for smooth transition. Colour to later selection by *Consultant* from manufacturer's full range. Adhesive type to be as recommended by manufacturer.
 - .2 Acceptable *Product*:

Resilient Sheet Flooring

- .1 Johnsonite CD-XX-A, colour to later selection by *Consultant* from manufacturer's full range.
- .2 Metal transition trim:
 - .1 Acceptable *Product*:
 - .1 Schluter-Schiene-E, stainless steel E30.
 - .2 Schluter-Schiene 'RENO Series'
- .6 Sealant: Mildew resistant sealant in accordance with Section 07 92 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Ensure that field conditions have been provided as requested and specified.
- .2 Ensure that substrates have been provided as specified without holes, protrusions, cracks greater than 1.6 mm (0.06") wide, unfilled control joints, depressions greater than 3 mm (1/8") deep, or other major defects.
- .3 Substrates shall be firm, structurally sound, sufficiently porous, and dry.
- .4 Examine substrate to ensure clean lines, correct level and freedom from cracks, ridges, dusting, scaling and carbonation.
- .5 Examine floors in advance of application of flooring to ensure that floors are protected against entry of water and moisture. Perform compatibility test with primer/adhesive and substrate.
- .6 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- .7 Failure to call attention to defects or imperfections will be construed as acceptance and approval of the substrate. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.
- .8 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

3.2 Preparation

- .1 Comply with recommendations of ASTM F710-19e1.
- .2 Substrates shall be free of wax, oil, silicone, soap, grease, dust, solvents, sealers, curing compounds, hardeners, alkaline salts, excessive carbonation or laitance, mould, mildew, paints, varnish, asphalt, residual adhesives, adhesive removers, or other contaminants or deleterious material that may inhibit bond strength or act as a bond breaker. Remove such contaminants and deleterious material using mechanical methods recommended by manufacturer. Do not use chemical abatement methods.
- .3 Concrete substrates that are loose, sandy, scaly, or have a white powdery surface are not acceptable. Substrates shall be mechanically prepared.
- .4 Flooring substrates shall be smooth and level within a tolerance of 3 mm (1/8") in a 3 m (10'-0") radius.
- .5 Fill surface cracks, holes, score marks, depressions, and grooves, and repair surface spalls with Portland cement patching or levelling compound.

Resilient Sheet Flooring

- .6 At door opening locations where finished flooring is adjacent to weather-stripping or automatic door bottoms provide trowel-applied levelling compound to provide full contact between finished flooring and weather-stripping or automatic door bottoms. Taper trowel-applied levelling compound to transition with adjacent flooring substrate to provide smooth and seamless transition at maximum slope of 3:1000 (height to distance) ratio.
- .7 Expansion joints, isolation joints, and other movement joints in substrates shall not be filled with patching or levelling compound.
- .8 Remove bumps, high spots, peaks and ridges to produce a uniform and smooth substrate.
- .9 Prepare substrates so that installation of flooring shall not show telegraphing of substrate.
- .10 Remove chalking and dusting and loose material from concrete surfaces with wire brushed or by scraping.
- .11 Sweep and vacuum clean substrates minimum 24 hours prior to alkalinity, moisture, and adhesion testing. Do not use sweeping compounds.
- .12 Notify *Consultant* of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.
- .13 Alkalinity, moisture, and adhesion bond testing:
 - .1 Test substrates in accordance with paragraph 3.5 Field Quality Control after mechanically preparing subfloor or applying patching and levelling compounds.
 - .2 Proceed with installation only after substrates pass testing. Document tests performed and submit in writing to *Consultant*.
- .14 Do not install floor coverings until they are same temperature as space where they are to be installed.
 - .1 Move floor coverings and installation materials to acclimatize in spaces where they will be installed at least 48 hours in advance of installation.
- .15 Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. Do not use sweeping compounds.
- .16 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials to achieve flush floor finish between adjacent flooring materials unless otherwise indicated.
- .17 Spray paints, permanent markers and other indelible ink markers shall not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and permanently stain the flooring material. If such contaminants are present on the substrate they shall be mechanically removed prior to the installation of the flooring material.

3.3 Flooring Installation

- .1 Verify product type, size, thickness, and colour prior to commencing installation. Do not install flooring with visual imperfections, colour variations or apparent defects.
- .2 Allow material to relax unrolled overnight, minimum 12 hours in installation areas.
- .3 Install rolls and cuts in sequence following manufacturer's installation requirements/diagrams.
 - .1 Lay flooring with joints parallel to building lines to produce symmetrical pattern and minimum joints.
 - .2 Place seams in inconspicuous and low-traffic areas, at least 150 mm (6") away from parallel joints in levelling underlayment, concrete joints, saw cuts and other type of joints.

Resilient Sheet Flooring

- .3 Avoid cross seams.
- .4 Lay sheet flooring centered in corridors, with equal sized sheet to either side of center sheet.
- .5 Mitre intersections at corridors typically. "T" type corridors shall be butt type installation.
- .6 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.
- .7 Layout seaming uniformly, using full length flooring typically, minimum flooring size of not less than roll width. Limit quantity of less than full length floor pieces at corridors to maximum of 1.
- .8 Layout flooring to match reviewed shop drawings floor pattern including borders and accents.
- .9 Match edges of floor coverings for colour shading at seams.
- .4 Cutting and fitting sheets:
 - .1 Cut pieces to length allowing approximately 75 mm (3") to 150 mm (6") excess for trimming.
 - .2 Remove 12.7 mm (1/2") off the factory seam edge using an edge trimmer or straight edge and knife.
 - .3 Cut sheet and fit neatly around fixed objects without gaps.
 - .4 Position remaining sheets so that the top sheet overlaps the previous sheet by 12.7 mm (1/2") to 19 mm (3/4").
 - .5 Install one sheet at a time in wet adhesive.
 - .6 Roll the flooring immediately in both directions using 45 kg (100 lb) three-section roller.
 - .7 After the material has been laid and rolled in wet adhesive, underscribe the seam using the short scribes with a scribed pin right away.
 - .8 Cut the material along the scribe line using a hooked blade knife and holding it at an angle so to slightly undercut the material.
 - .9 Roll the seam with a hand roller.
 - .10 Cross seams:
 - .1 Straight edge and undercut at an angle the end of the first sheet.
 - .2 Spread adhesive and lay in wet adhesive.
 - .3 Roll the flooring immediately in both directions using 45 kg (100 lb) three-section roller.
 - .4 Overlap the second sheet at butt seam approximately 25 mm (1").
 - .5 Adhere second sheet except for last 450 mm (18") of butt seam; wait 20 – 30 minutes.
 - .6 Spread the adhesive for the last 450 mm (18"), lay in material, underscribe the seam to a neat, fit cut, and roll flooring immediately in both directions using 45 kg (100 lb) three-section roller.
- .5 As installation progresses, roll flooring with 45 kg (100 lb) three-section roller to ensure full adhesion, remove adhesive ridges, and entrapped air.
- .6 Where cove base is not required, seal joint at wall with manufacturer's approved sealant.

Resilient Sheet Flooring

- .7 Apply adhesive uniformly and at spreading rates in accordance with adhesive manufacturer's requirements. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .8 Obtain 100% adhesive coverage to flooring backing.
- .9 Install flooring to entire area indicated or scheduled, including coverplates occurring within finished floor areas. Maintain overall continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Cut flooring to floor drains occurring within finished floor areas.
- .10 Heat-welded seams:
 - .1 Weld seams in accordance with ASTM F1516-13(2018).
 - .2 Wait minimum of 24 hours after flooring installation before grooving and heat welding seams.
 - .3 Prepare, weld, and trim seams to produce flat surfaces flush with adjoining floor covering surfaces.
 - .4 Rout joints to approximately 2/3 of the thickness of the material and use welding bead to permanently fuse sections into a seamless floor covering. Groove shall be between 3 mm (0.118") and 3.5 mm (0.138") wide.
 - .5 Using a weld plate and skiving knife to make first cut and allow weld rod to fully cure to room temperature.
 - .6 Using a skiving knife only, finish the trimming of the remainder of the weld. The finish should be smooth and on the same level as the flooring.
 - .7 Trimming of welded joint while warm is not permitted unless final trimming is performed after weld has cooled to flooring temperature. Excess weld shall be removed using a heated standard putty knife.
 - .8 Roll the seam area with 45 kg (100 lb) three-section roller.
 - .9 Maximum variation of welds from plane or from straight: 6 mm (1/4") in 3 m (10 ft) length using a 3 m (10 ft) straight edge.
- .11 Flooring installation shall not show telegraphing of substrate. Flooring installation shall be homogenous free of substrate lines, pockets, bumps and unevenness.

3.4 Installation - Transition Trim

- .1 Protect exposed edges of flooring, where finished and unfinished areas adjoining, by means of a transition trim butting to and flush with the finished surface of the flooring covering material and securely adhered to the substrate material.
- .2 Coordinate transitions with work of other sections.
- .3 Allow coiled material to lay flat for at least 24 hours at ambient temperatures specified above prior to installation.
- .4 Set to ensure installation is free of gaps.
- .5 Install in longest lengths possible.
- .6 Install straight to maximum allowable variation of 3 mm (1/8") over 3 m (10'-0").
- .7 Scribe and fit to obstructions.
- .8 Fit joints tightly, straight and vertical as applicable and not less than 610 mm (24") from corners.

Resilient Sheet Flooring

- .9 Mitre corners.

3.5 Field Quality Control

- .1 Conduct quality control.

- .1 Field tests and inspections:

- .1 Moisture and alkalinity:

- .1 Test for moisture vapour transmission in accordance with ASTM F710-19e1 and ASTM F1869-16a or ASTM F2170-19a in accordance with manufacturer's written flooring installation requirements. Results must not exceed 170 µg/m² (3 lb per 1,000 ft²) in 24 hours when tested to ASTM F1869-16a, or exceed 75% when tested to ASTM F2170-19a.
 - .2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-19e1.
 - .3 For each test type: Conduct 3 tests for flooring applications up to 93 m² (1000 ft²) in area, and 1 additional test for each additional 93 m² (1000 ft²) of flooring area.

- .2 Adhesion bond test:

- .1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.
 - .2 Select six substrate test areas, each 915 mm (3'-0") x 915 mm (3'-0") in size. Test areas shall be spaced a minimum 1220 mm (48") apart.
 - .3 Cut 915 mm (3'-0") x 915 mm (3'-0") panels from specified material.
 - .4 Using the specified adhesive, glue down each panel using adhesive manufacturer's recommended trowel.
 - .5 After 72 hours, attempt to remove the panels of flooring by pulling up from the corners.

- .2 Provide manufacturer's field review.

3.6 Adjusting and Cleaning

- .1 Remove excess adhesive from surfaces of the sheet flooring as work progresses.
- .2 Thoroughly clean surfaces in accordance with manufacturer's recommendations.

3.7 Protection

- .1 Prohibit foot traffic on installed flooring for a period of 24 hours after installation. No heavy traffic, rolling loads, or furniture placement are permitted for a minimum of 72 hours after installation.
- .2 Protect new floors from time of final set of adhesive until final inspection.
- .3 Install floor protection in areas where work, repairs and installation of equipment, and foot traffic will occur.

3.8 Maintenance

- .1 Perform initial maintenance according to the manufacturer's written requirements.
- .2 Allow flooring to dry prior to applying protection.

END OF SECTION

Painting

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Painting of interior paintable surfaces matching existing adjacent.
- .2 Paintable and non-paintable surfaces:
 - .1 Paint and finish paintable surfaces included in the *Work*, except where excluded by the *Contract Documents*.
 - .2 The following surfaces are considered non-paintable, except as otherwise indicated or scheduled:
 - .1 Material and equipment furnished prime and finish painted.
 - .2 Internal surfaces of steel tanks and stacks.
 - .3 Sprayed fire-resistive materials.
 - .4 Stainless steel, weathering steel, copper, bronze, chromium plate, nickel, anodized or lacquered or mill finished aluminum, Monel metal.
 - .5 Metallic and mastic insulation finishes.
 - .6 Abrasive material finishes on floors, stair treads, stair nosing and landings.
 - .7 Insulated electric cables.
 - .8 Machined parts of machinery and equipment.
 - .9 Concealed surfaces.
 - .10 Manufactured finish materials.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting.

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets and list of *Products* proposed for use in the work of this section.
- .2 Samples:
 - .1 Samples for initial paint colour and finish selection:
 - .1 Submit 3 drawdowns of each matching colour for review by *Consultant* and resubmit to *Consultant* as required to obtain approval. Drawdown to be of specified colour, sheen, and paint formula for applicable surface.
 - .2 Samples for verification:
 - .1 Submit 3 samples on 200 mm x 305 mm (8"x 12") material of same type as that on which coating is to be applied, for *Consultant's* approval, at least 30 days before materials are required.
 - .2 Identify each sample as to *Project*, finish, formula, colour name, number, gloss name and number, date and name of *Contractor* and painting *Subcontractor*.

Painting

.3 Resubmit as required until colours and gloss value are approved.

1.4 Closeout Submittals

.1 Operation and maintenance data:

.1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

.2 Maintenance materials:

.1 Provide 1 sealed containers, 2 litres (1/2 gallon) capacity of each paint product in each colour used in the *Work* for *Owner's* maintenance use. Containers shall be new, clearly labelled with manufacturer's name, type of paint, colour and colour number. Store at *Place of the Work* where directed by *Owner*.

1.5 Quality Assurance

.1 Qualifications

.1 Manufacturers:

.1 Paint manufacturers and *Products* used shall be as listed under the Approved Product List section of the MPI Painting Manual.

.2 Installers / applicators / erectors:

.1 Only qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency" shall be engaged in painting work. Apprentices shall work under the direct supervision of a qualified journeyman in accordance with trade regulations.

.2 Mock-ups:

.1 Provide mock-ups of each paint system for indicated surfaces of each colour and finish selected to verify preliminary paint selections made under Sample submittals.

.2 Do not proceed with work, including ordering of paint *Products*, until mock-ups of each paint colour and finish and paint system for indicated surfaces have been reviewed and accepted by *Consultant*.

1.6 Delivery, Storage, and Handling

.1 Deliver painting materials in sealed, original labelled containers bearing manufacturer's name, brand name, type of paint or coating and colour designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.

.2 Store paint *Products* and materials in original labelled containers in secure (lockable), dry, heated and well ventilated single designated area meeting minimum requirements of both paint manufacturer and authorities having jurisdiction, and at a minimum ambient temperature of 7°C.

.3 Protect floor and wall surfaces of storage area. Protect floors with sheets or clean plywood or metal pans where mixing is being carried out.

1.7 Field Conditions

.1 Ambient conditions:

.1 Comply with environmental requirements of MPI Manual.

.2 Perform no painting work when ambient air and substrate temperatures are below 10°C for both interior work, unless suitable weatherproof covering and sufficient heating and ventilation facilities are in place in accordance with MPI Manual.

Painting

- .3 Perform no painting work when relative humidity is above 85% or when dew point is less than 3°C (5°F) variance between air/surface temperature.

PART 2 - PRODUCTS

2.1 Materials

- .1 *Products* listed in MPI Manual shall be used in the *Work*, unless specified otherwise.
- .2 Paint and materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, and the like) shall be in accordance with the MPI Manual "Approved Product" listing and shall be from a single manufacturer for each system used.
- .3 Other paint materials, such as linseed oil, shellac, and the like, shall be highest quality *Products* of an approved manufacturer listed in the MPI Manual and shall be compatible with other coating materials as required.
- .4 Paint materials shall have good flowing and brushing properties and shall dry or cure free of blemishes or sags.
- .5 Where required, paints and coatings shall meet flame spread and smoke developed ratings designated by building code requirements and/or authorities having jurisdiction.

2.2 Equipment

- .1 Painting and coating equipment in accordance with written requirements of MPI Manual.

2.3 Mixing and Tinting

- .1 Unless otherwise specified, paints shall be ready-mixed. Re-mix prior to application to ensure colour and gloss uniformity.
- .2 Paste, powder or catalyzed paint mixes shall be mixed in accordance with manufacturer's written instructions.
- .3 Perform colour tinting operations prior to delivery of paint to *Place of the Work*.
- .4 Where thinner is used, addition shall not exceed paint manufacturer's recommendations.

2.4 Colours and Gloss Levels

- .1 Paint colours and gloss levels shall match adjacent surfaces in terms of colour, texture and sheen, sample to be reviewed and approved by the *Consultant*.
- .2 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI values:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat finish	0 to 5	10 maximum
G2	Velvet finish	0 to 10	10 to 35
G3	Eggshell finish	10 to 25	10 to 35
G4	Satin finish	20 to 35	35 minimum
G5	Semi-Gloss finish	35 to 70	
G6	Gloss finish	70 to 85	
G7	High-Gloss finish	> 85	

Painting

PART 3 - EXECUTION

3.1 Examination

- .1 Prior to commencement of work of this section, thoroughly examine surfaces scheduled to be painted.
- .2 Check moisture content and alkalinity of surfaces to be painted in accordance with paragraph above titled Field Conditions.
- .3 Inspect surfaces to be coated for gouges, marks, nibs, and other defects and properly prepare patching, filling, smoothing or other surface preparation necessary to ensure satisfactory finish.
- .4 Report in writing any condition adversely affecting work of this section.
- .5 Proceed with work only when surfaces and conditions are satisfactory. Remove dust, grease, rust, scale and extraneous matter, tool and machine marks and insects from surfaces which could be detrimental to a satisfactory and acceptable finish.

3.2 Preparation

- .1 Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- .2 Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - .1 After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- .3 Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, mildew, grease, and incompatible paints, encapsulants, and other deleterious materials.
- .4 Paint surfaces when moisture content or alkalinity of surfaces to be painted comply with paragraph 3.5 Field Quality Control / Standard of Acceptance.
- .5 Concrete substrates: Remove release agents, curing compounds, efflorescence, and chalk.
- .6 Existing painted substrates:
 - .1 Clean substrates as indicated above.
 - .2 Sound existing paint surfaces and remove paint surfaces that are not sound, loose or are otherwise stained, cracked, wrinkled, peeling, or defective.
 - .3 Dull hard or glossy surfaces by sanding or other abrasive methods prior to finishing.
 - .4 Apply tie-coat primer product that compatible with substrate as recommended by paint coatings manufacturer.
 - .5 Follow with paint finish coats as specified for like substrate materials specified herein.
 - .6 Sand, clean, dry, etch, neutralize and/or test all surfaces under adequate illumination, ventilation and temperature requirements.
 - .7 Protect from repainting operations interior surfaces and areas, including adjacent surfaces and equipment and any labels and signage. Make good any damage caused by failure to provide suitable protection.

Painting

3.3 Installation

- .1 Do not paint unless substrates are acceptable and/or until Field Conditions (heating, ventilation, lighting and completion of work of other sections) are acceptable for applications of *Products*.
- .2 Apply primer, paint or stain in accordance with MPI Manual Premium Grade finish requirements.
- .3 Apply paint and coatings within an appropriate time frame after cleaning when Field Conditions encourage flash-rusting, rusting, contamination or manufacturer's paint specifications require earlier applications.
- .4 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer's recommendations.
- .5 Tint each coat of paint progressively lighter to enable confirmation of number of coats.
- .6 Unless otherwise approved Consultant, apply a minimum of 4 coats of paint where deep or bright colours are used to achieve satisfactory results.
- .7 Sand and dust between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1000 mm (39").
- .8 Do not apply finishes on surfaces that are not sufficiently dry. Unless manufacturer's directions state otherwise, each coat shall be sufficiently dry and hard before a following coat is applied.
- .9 Prime coat of stain or varnish finishes may be reduced in accordance with manufacturer's directions.
- .10 Paint finish shall continue through behind wall-mounted items (i.e. chalk and tack boards).
- .11 Exposed means visible in complete work including interiors of cupboards and closets, tops of doors, trim, and the like, whether in sight line or not, including behind surface mounted fixtures and heating units.
- .12 *Consultant* shall have right to make changes in colour tone of finishes prior to final coat to obtain desired results without additional cost to *Owner*.
- .13 Access doors, prime coated butts and other prime painted hardware, registers, radiators and covers, exposed piping and electrical panels shall be painted to match adjacent surfaces in terms of colour, texture and sheen, unless otherwise indicated.

3.4 Adjusting and Cleaning

- .1 Promptly as work proceeds and on completion of *Work*, remove paint where spilled, splashed or spattered during the progress of the *Work*. Keep the premises free from unnecessary accumulation of tools, equipment, surplus materials and debris; at the conclusion of the work leave the premises clean.

3.5 Interior Paint Systems

- .1 System references listed are based on MPI Manual and are Premium Grade, unless otherwise indicated:
 - .1 Concrete vertical surfaces: (including ceilings)
 - .1 INT 3.1A Latex finish (over primer); eggshell.
 - .2 Concrete horizontal surfaces: (floors and stairs)
 - .1 INT 3.2A Latex floor enamel finish; semi-gloss.
 - .3 Concrete masonry unit assemblies:

Painting

- .1 INT 4.2P High performance architectural latex finish (over alkali resistant primer/block filler); eggshell.
- .4 Plaster and gypsum board: (gypsum wallboard and drywall)
 - .1 INT 9.2B High performance architectural latex finish:
 - .1 Gloss level:
 - .1 Ceilings, except as otherwise indicated: flat.
 - .2 Wet and service areas; ceilings: semi-gloss.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Tackboards.
 - .2 Marker Boards (Whiteboards)
 - .3 Related trim, adhesives, and fastenings.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Show proposed system of anchorage and materials being supplied on shop drawings submitted for review.
 - .2 Show dimensional layouts, hardware items, anchorage devices, dimensions, description of materials and finishes, and all other pertinent information.
- .4 Samples:
 - .1 Submit 305 mm x 305 mm (12" x 12") samples of each *Product* specified, diagonally cut to show cross section through assembly, complete with accessories and trim.

1.3 Closeout Submittals

- .1 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Erection of materials to be carried out by competent workers supervised by a foreperson with in this specialized field and approved in writing by manufacturer for installation of their *Product*.

1.5 Delivery, Storage, and Handling

- .1 Package *Products* to prevent distortion in shipment and handling. Label and protect finish surfaces by sturdy wrappings.

PART 2 - PRODUCTS

2.1 Design/Performance Requirements

- .1 Trademarks and labels:

Visual Display Surfaces

- .1 No trademarks or labels will be accepted on exposed finished work.

2.2 Tackboards

- .1 Cork tackboard: 12.7 mm (1/2") factory prelaminated consisting of 6 mm (1/4") thick natural cork laminated to 6 mm (1/4") particle board substrate under mechanical pressure in maximum panel sizes of 1219 mm x 2438 mm (4'-0" x 8'-0"). Bonding of materials by a waterproof adhesive that will not delaminate or rupture at the contact surfaces.

- .1 Colour of tackboard to be selected by *Consultant* from manufacturer's standard colour range.

- .2 Trim:

- .1 Aluminum trim in accordance with Trim Components paragraph below.

2.3 Marker Boards (Whiteboards)

- .1 Acceptable manufacturers:

- .1 ASI Visual Display Products.

- .2 Porcelain enamel board with porcelain enamel writing surface. Boards shall be manufactured in accordance with Porcelain Enamel Institute's standards. Gloss factor: 6-8 as measured by 45° glossmeter.

- .1 Face Sheet: 28 gauge Porcelain Enamel Steel.

- .1 Colour: White colour writing surface, designed for long lasting heavy duty marker writing surface, free of permanent marker staining.

- .2 Core:

- .1 11 mm (7/16") MDF.

- .3 Backing: moisture barrier back.

- .3 Joints shall be absolutely flush and level, plumb true with edges finished square and fitted as closely as possible. Use concealed joint fasteners.

- .4 Particle board backing to CAN3-0188.1-M78, 6 mm (1/4") thick, with sanded faces.

- .5 Concealed mechanical joining system: join abutting panels with a spline as recommended by the manufacturer.

- .6 Trim:

- .1 Aluminum trim in accordance with Trim Components paragraph below.

2.4 Miscellaneous Accessories

- .1 Reinforcing anchor plates to be galvanized steel plates conforming to CSA G4-09(2014).

- .2 Use screws, bolts of galvanized steel or aluminum.

- .3 Ferrous metal not specified must be plated or baked enamel and treated with primer conforming to CAN/CGSB 1.140-M91.

- .4 Provide with Angled Marker Rail by visual display surface manufacturer.

2.5 Trim Components

- .1 Acceptable Manufacturers:

Visual Display Surfaces

- .1 Similar to ASI Visual Display Products.
- .2 Aluminum trim:
 - .1 Acceptable Products:
 - .1 Series 200 trims as provided by Architectural School Products Ltd.
 - .2 or board approved alternate:
 - .1 264 marker tray over millwork
 - .2 261 marker tray where mounted less than 600mm A.F.F.
 - .3 #212 marker tray in all other locations
 - .4 207 divider between adjacent boards
 - .5 206 map rails
 - .6 205 perimeter trim
 - .3 Extruded aluminum components, AA6063 T5 or approved alternative, 25 mm x 25 mm x 3 mm (1" x 1" x 1/8"), mitred corners.
 - .4 Finish: etched and clear anodized 0.051 mm (0.002") satin finish free from extruding draw marks and surface scratches.
 - .5 Reveal: Provide 3.2 mm (1/8") reveal between board finish and aluminum frame.
 - .6 Final assembly to have seamless/welded flush and level butt joints. No visible joints accepted and no intermediate trim.

2.6 Attachment Hardware

- .1 Use manufacturer's standard mounting hardware.

PART 3 - EXECUTION

3.1 Examination

- .1 Prior to commencement of erection, check surfaces for irregularities, trueness and rigidity and projections and defects and immediately report in writing to *Contractor*.
- .2 Commencing installation implies acceptance of surface conditions.

3.2 Installation

- .1 Secured from behind and mounted in accordance with manufacturer's written requirements to satisfaction of *Consultant*.
- .2 Install secure, plumb and square.
- .3 Secure wall brackets to blocking in stud walls, or with zinc plated metal expansion type anchors at masonry back-up.
- .4 Locate seams as directed by *Consultant*.

3.3 Installation Tolerances

- .1 Install plumb, level, tight and secured. Comply with the following maximum tolerances:
 - .1 Plumb and level: 3 mm (1/8").

Visual Display Surfaces

- .2 Variation from indicated position: plus/minus 3 mm (1/8").

3.4 Adjusting and Cleaning

- .1 Verify under work of this section that installed *Products* function properly, and adjust them accordingly to ensure satisfactory operation.
- .2 Do not remove protective coatings until final cleaning, or earlier if directed by *Consultant*.
- .3 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at *Place of the Work* only if approved.

END OF SECTION

Prefinished Metal Lockers

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Prefinished metal lockers.

1.2 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .2 Shop drawings:
 - .1 Indicate thicknesses of metal, fabricating methods, assembled banks of lockers, bases, trim, numbering, filler panels, end panels, and tops.
- .3 Samples:
 - .1 Submit sample of colour and finish on actual base metal.

PART 2 - PRODUCTS

2.1 Materials

- .1 Lockers: to CAN/CGSB 44.40-2001 AMEND.
 - .1 Type:
 - .1 Single tier full-height locker.
 - .2 Size (width x depth x height):
 - .1 305 mm x 380 mm x 1830 mm (12" x 15" x 72").
 - .3 Locking system: suitable for padlocks.
 - .4 Metal materials: to ASTM A1008/A1008M-11, free of imperfections.
 - .5 Frame: 1.6 mm (0.0625") thick (16 gauge).
 - .6 Door:
 - .1 Minimum 1.6 mm (0.0625") thick (16 gauge) outer panel and 1.0 mm (0.0375") thick (20 gauge) liner, hollow core or honeycomb.
 - .7 Shelves: minimum 1.6 mm (0.0625") thick (16 gauge).
 - .8 Hooks: three single and one double prong coat hooks.
 - .9 Body: minimum 0.6 mm (0.025") thick (24 gauge).
 - .10 Sloped top: minimum 20 gauge, mitred at corners.
 - .11 Filler and end panels: minimum 1.6 mm (0.0625") thick (16 gauge).
 - .12 Ventilation: Airflow shall be achieved through louvers or perforates in the vertical frame members or door.
 - .13 Base:

Prefinished Metal Lockers

- .1 Locker manufacturer's standard minimum Height to match existing.
- .14 Number plates: Each door shall have a number plate riveted onto body or door pull, numbered sequentially to match existing for each locker Type as directed by the *Consultant*.
- .15 Locker finish; exposed and semi-exposed surfaces: baked on polymer powder or alkyd enamel, colour to later selection by the *Consultant*. Frame colour shall match door colour unless otherwise indicated.
- .16 Acceptable manufacturers/*Products*:
 - .1 Anthony Steel 'Atlas Institutional'
 - .2 ASI Group Canada 'Traditional'
 - .3 GSS Lockers 'Elite'

PART 3- EXECUTION

3.1 Installation

- .1 Assemble and install lockers complete with metal base in accordance with manufacturer's written installation requirements.
- .2 Securely fasten at least every third locker through to wall studs, masonry or concrete substrate.
- .3 Install trim and filler panels where required for continuous appearance and where obstructions occur. Specific conditions as indicated.
- .4 Install finished end panels to exposed ends of locker banks.

3.2 Installation Tolerances

- .1 Install plumb, level, tight and secured. Comply with the following tolerances:
 - .1 Plumb and level: 3 mm (1/8").
 - .2 Variation from indicated position: plus/minus 3 mm (1/8").

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Roller window sun shades at interior locations.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting.

1.3 Submittals

- .1 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
 - .2 Submit flammability performance data.
 - .3 Submit manufacturers' installation instructions.
- .2 Shop drawings:
 - .1 Submit shop drawings or fully dimensioned catalogue cuts.
 - .2 Window treatment schedule: Use same designations indicated on *Contract Documents*.
 - .3 Clearly indicate general construction, configurations, jointing methods and locations, fastening methods, handing of controls, required blocking locations, banding (tandem shades), and installation details.
- .3 Samples:
 - .1 Submit samples of each material and finish colour selected and each accessory.

1.4 Closeout Submittals

- .1 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 Company specializing in manufacturing the *Products* specified in this section, with minimum 10 years experience.
 - .2 Installers / applicators / erectors:
 - .1 Work of this section shall be by forces in the direct employ or under control of the system manufacturer, skilled, trained, and experienced in work of similar scope and complexity.

1.6 Delivery, Storage, and Handling

- .1 Before delivery to the *Place of the Work*, check each shade for operation; remove finger marks and smudges.
- .2 Package *Products* to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.

PART 2- PRODUCTS

2.1 Manufacturers/Products

- .1 Specifications are based on products from Sun Glow Window Covering Products of Canada Ltd. The following listed manufacturers are acceptable only when in compliance with requirements of this section.
- .2 Subject to compliance with requirements, provide *Products* by one of the following manufacturers:
 - .1 Altex – SunProject.
 - .2 Draper Inc.
 - .3 Elite Window Fashions.
 - .4 Levolor Inc.
 - .5 MechoShade Systems, Inc.
 - .6 Sun Glow Window Covering Products of Canada Ltd.
 - .7 Substitutions: in accordance with Section 01 25 00.
- .3 Acceptable *Product*:
 - .1 Sun Glow Window Covering Products of Canada Ltd. 'Vision Roller Shade Systems'.

2.2 Hardware - Manual Controlled Shades

- .1 Chain operated, with infinite positioning. Left or right hand operation and banding as applicable to suit *Place of the Work* condition. Operation to later selection by Consultant.
 - .1 Drive assembly:
 - .1 Must allow finger tip control and include a built in shock absorber system to prevent chain breakage under normal operating conditions;
 - .2 Capable of being field adjusted from the exterior of the shade unit without having to disassemble the hardware.
 - .3 Drive Chain: No. 10 stainless steel bead chain formed in a continuous loop. The chain shall have passed a 40 kg (90 lb) load test.
 - .1 *Provide* child-safe chain retainers.

2.3 Assembly

- .1 *Provide* fully factory assembled shade unit consisting of 2 shade brackets, one piece extruded aluminum shade tube, extruded aluminum fascia, aluminum profile hembars, extruded vinyl fabric spline, and fabric as specified.
- .2 Fabric shall hang straight, without shifting sideways more than 3 mm (1/8") in either direction due to warp distortion or weave design.
- .3 Factory modify housings where necessary to bypass columns.

Roller Window Shades

- .4 End brackets: a two piece molded ABS construction with nylon drive sprocket.
- .5 Shade tube: Minimum 1.52 mm (0.060") thick extruded aluminum with three equally spaced continuous stiffening fins, non-sag design, maximum deflection under full load of fabric L/700.
- .6 Hembar: Extruded aluminum with matching plastic end finials.
- .7 Mounting: Removal of shade system shall not require the disassembly of the shade unit.

2.4 Shade Mounting System

- .1 Extruded aluminum bracket designed to accept preassembled shade system.
 - .1 Brackets to be used to facilitate the alignment with shade opening.
- .2 Modular construction: Shades must be removable as a complete modular unit without any component disassembly required.

2.5 Shade Fabric Types

- .1 Sun control fabric; dimensionally stable shade fabric:
 - .1 Acceptable *Products*; 1% open for classroom, 3% open area for administration and other areas:
 - .1 Solar Shade fabric by Sunglow to later selection by Consultant.
 - .2 Fabric shall hang flat, without buckling or distortion. Edge, where trimmed, shall hang true and straight, without shifting sideways more than 3 mm (1/8") in either direction due to warp distortion or weave design.
 - .3 Flammability performance:
 - .1 Certified by an independent laboratory, shade fabric shall pass CAN/ULC S109-14 Flame Tests of Flame Resistant Fabrics and Films.

2.6 Fabrication

- .1 Finished assemblies shall be, square, true to size and free from distortion, twist, or other defects that could affect their strength, operation or appearance. Factory applied finish shall be uniform, smooth and without blemishes.

PART 3 - EXECUTION

3.1 Installation

- .1 Install shade systems in plumb, squared, adequately anchored, maintaining uniformed clearances, accurate alignment levels, and parallel with the window plane. Fabric shall not travel more than 3 mm (1/8") in either direction within channels after installation.
- .2 Fabric shall be pre-measured and manufactured off-site.
- .3 Shades shall be snapped into place without screws or visible fasteners.
- .4 Incorporate reinforcing, fastening and anchorage required for installation of shades.
- .5 Securely attach installation fittings to their mounting surfaces with stainless steel or hardened aluminum screws of proper length and type, and durable anchors.
- .6 Install shade roller true and level, and with cloth to hang flat without buckling or distortion.

Roller Window Shades

3.2 Adjusting and Cleaning

- .1 Verify that installed shade system functions properly, and adjust it accordingly to ensure satisfactory operation.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible.

END OF SECTION

1 General

1.01 References

- .1 Division 00 and Division 01 apply to and are a part of each Mechanical Division:
 - .1 Division 21 – Fire Suppression;
 - .2 Division 22 – Plumbing;
 - .3 Division 23 – Heating, Ventilating, and Air Conditioning;
 - .4 Division 25 - Integrated Automation.

1.02 Application

- .1 This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Sections of Mechanical Divisions. It is intended as a supplement to each Section and is to be read accordingly.

1.03 Submittals

- .1 Submit shop drawings/product data sheets for:
 - .1 pressure gauges and thermometers;
 - .2 electric motors (submit with equipment they are associated with).
- .2 Submit weight loads for selected equipment (upon request).
- .3 Submit copy of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations.
- .4 Submit a list of equipment identification nameplates indicating proposed wording and sizes.
- .5 Submit a list of pipe and duct identification colour coding and wording.
- .6 Submit a proposed valve tag chart and a list of proposed valve tag numbering and identification wording.
- .7 Submit drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.
- .8 As specified in Part 2 of this Section, submit a spare belt set, tagged and identified, for each belt driven piece of equipment.
- .9 Submit any other submittals specified in this Section or other Sections of Mechanical Divisions.

2 Products

2.01 Pipe Sleeves

- .1 Galvanized Sheet Steel – Minimum #16 gauge galvanized steel with an integral flange at one end to secure sleeve to formwork construction.
- .2 Polyethylene – Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.
- .3 Waterproof Galvanized Steel Pipe – Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at sleeve midpoint.
- .4 Galvanized Steel or Cast Iron Pipe – Schedule 40 mild galvanized steel, or Class 4000 cast iron.

2.02 Firestopping and Smoke Seal Materials

- .1 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in Section 20 05 17 - Sleeves and Sleeve Seals for Mechanical Piping and work is to be done as part of mechanical work unless otherwise specified in Division 07.

2.03 Waterproofing Seal Materials

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so when bolts are tightened the links expand to seal the opening watertight. Select seal assemblies to suit pipe size and sleeve size or wall opening size.
- .2 Acceptable products are:
 - .1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S-316;
 - .2 The Metraflex Co. "MetraSeal" type ES.

2.04 Pipe Escutcheon Plates

- .1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to building surface, each plate sized to completely cover pipe sleeve or building surface opening, and to fit tightly around pipe or pipe insulation.

2.05 Piping Hangers and Supports

- .1 Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to following requirements:
 - .1 unless otherwise specified, ferrous hanger and support products are to be electro-galvanized;
 - .2 hangers and supports for insulated piping are to be sized to fit around insulation and insulation jacket.
- .2 Hangers and supports for horizontal suspended piping as follows:
 - .1 adjustable steel clevis hanger – MSS Type 1;
 - .2 adjustable swivel ring band hanger – MSS Type 10;
 - .3 adjustable roller hanger – MSS Types 41, 43, and/or 45, with MSS Type 39 steel protection saddle.
- .3 Supports for horizontal pipe on vertical surfaces as follows:
 - .1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;
 - .2 heavy-duty steel pipe clip – MSS Type 26;
 - .3 single steel pipe hook – Myatt Fig. 156;
 - .4 epoxy coated steel pipe stays are not permitted.
- .4 Floor supports for vertical risers as follows:
 - .1 copper tubing riser clamp – MSS Type 8;
 - .2 heavy-duty steel riser clamp – MSS Type 8.

- .5 Supports for vertical piping on vertical surfaces as follows:
 - .1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;
 - .2 heavy-duty steel pipe bracket or soil pipe bracket – MSS Type 26;
 - .3 extension split pipe clamp – MSS Type 12;
 - .4 epoxy coated steel pipe stays are not permitted.
- .6 Base support for vertical risers in excess of 6 m (20') high extending out from base mounted equipment is to consist of a base elbow support with flange.
- .7 For horizontal pipe on racks, Unistrut or equal galvanized steel pipe racks with pipe securing hardware as follows:
 - .1 standard galvanized steel U-bolts/clamps supplied by rack manufacturer;
 - .2 adjustable roller chair – MSS Type 44 with MSS Type 39 steel protection saddle.
- .8 Special hangers and supports for various applications as follows:
 - .1 vibration isolated riser supports – black steel riser clamps as specified above, complete with neoprene–steel–neoprene sandwich type vibration isolation pads between clamp and floor;
 - .2 for groups of pipes having same slope – MSS Type 32 welded steel brackets, Anvil Fig. 46 universal trapeze assemblies, or Unistrut or equal support assemblies, all with U-bolts, clamps, etc., to secure pipes in place;
 - .3 for sections of piping connected to vibration isolated equipment – hangers and supports as specified above but complete with MSS Type 48 spring cushions;
 - .4 for plastic piping – generally as specified above but in accordance with pipe manufacturer's recommendations;
 - .5 for fire protection piping – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of NFPA Standard applicable to piping system;
 - .6 for bare horizontal copper piping – generally as above but factory vinyl coated to prevent direct copper/steel contact;
 - .7 for bare copper vertical piping – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate pipe from clamp;
 - .8 insulation protection shields to and including 40 mm (1-1/2") dia. – MSS Type 40 galvanized steel shields with ribs to keep shield centred on hanger.
- .9 Hanger rods are to be electro-galvanized carbon steel (unless otherwise specified), round, threaded, to ASTM A36, complete with captive machine nuts with washers at hangers, sized to suit loading in accordance with Table 3 in MSS SP-58, but in any case minimum 9.5 mm (3/8") diameter.
- .10 Acceptable manufacturers are:
 - .1 E. Myatt & Co. Inc.;
 - .2 Anvil International Inc.;
 - .3 Empire Industries Inc.;
 - .4 Hunt Manufacturing Ltd.;
 - .5 Unistrut Canada Ltd.;

- .6 Nibco Inc. "Tolco";
- .7 Taylor Pipe Supports.

2.06 Access Doors

- .1 Provide all access doors required for Mechanical work unless otherwise specified in Division 08. Coordinate consistency of look and finish of access doors on project with each Division of Work. Coordinate exact requirements with General Trades Contractor.
- .2 Access doors to be rust resistant steel door panels, with concealed hinges and positive locking and self-opening screwdriver operated lock. Wall type frame to be suitable for wall installation and have integral keys for plaster walls. Doors in tile wall to be stainless steel and in ceilings to be suitable for plaster covering with only frame joint showing. Other doors to be prime painted steel.
- .3 Size access doors to suit the concealed work for which they are supplied, and wherever possible they are to be of 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.
- .4 Lay-in type tiles, properly marked, may serve as access panels. Coordinate marking of ceiling tiles with Consultant. Panels in glazed tile walls to be 12 gauge, 304 alloy stainless steel, No. 4 finish, with recessed frame secured with stainless steel counter-sunk flush head screws.
- .5 Panels in plaster surfaces to have dish-shaped door and welded metal lath, ready to take plaster. Provide a plastic grommet for door key access.
- .6 Other access doors to be welded 12 gauge steel, flush type with concealed hinges, lock and anchor straps, complete with factory prime coat. Submit to Consultant for review, details of non-standard door construction details.
- .7 Access doors in fire rated ceilings, walls, partitions, structures, etc., to be ULC listed and labelled and of a rating to maintain fire separation integrity.
- .8 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting finish in which they are to be installed so as to maintain final building surface appearance throughout.
- .9 Acceptable manufacturers include Le Hage, SMS, Pedlar and Acudor.

2.07 Pressure Gauges and Thermometers

- .1 Pressure gauges as follows:
 - .1 adjustable, glycerine filled, 115 mm (4" or 4-½") diameter and each accurate to within 1% of scale range;
 - .2 Stainless steel or aluminum case and dial display;
 - .3 dual scale white dial with a scale range such that working pressure of system is at approximate mid-point of scale;
 - .4 Provide two (2) year warranty. Contract to extend manufacturer standard warranty where required.
- .2 Pressure gauge accessories and additional requirements as follows:
 - .1 a bronze ball type shut-off valve is to be provided in the piping to each pressure gauge;
 - .2 each pressure gauge for piping and equipment with normal everyday flow is to be equipped with a brass pressure snubber;
 - .3 pressure gauges in fire protection piping must be ULC listed and labelled.
- .3 Thermometers as follows:

- .1 225mm (9") impact resistant case, universal angle and adjustable, with separable thermowell, red or blue non-mercury fluid;
 - .2 Provide extensions and pipe fittings where required to suit insulation or to reach fluid flow for accuracy of reading;
 - .3 Dual scale C/F to suit system temperature;
 - .4 Provide two (2) year warranty. Contract to extend manufacturer standard warranty where required.
- .4 Acceptable manufacturers are:
- .1 Winters 9IT/PCT series;
 - .2 Weiss Instruments;
 - .3 Terrice;
 - .4 Ashcroft.

2.08 Equipment Belt Drives

- .1 ANSI/RMA Standard V-belt type rated at minimum 1.5 times motor nameplate rating, and in accordance with following requirements:
 - .1 belts are to be reinforced cord and rubber, and multiple belts are to be matched sets;
 - .2 sheaves are to be cast iron or steel, secured to shafts with removable keys unless otherwise specified, standard adjustable pitch ($\pm 10\%$ range) for motors under 10 HP, fixed pitch type with split tapered bushing and keyway for motors 10 HP and larger, and, if required, replaced as part of mechanical work to suit system air/water quantity testing and balancing work;
 - .3 motor slide rail adjustment plates are to allow for centre line adjustment.
- .2 Supply a spare belt set (tagged and identified) for each belt drive and hand to Owner upon Substantial Performance of the Work.

2.09 Equipment Drive Guards and Accessories

- .1 For V-belt drives – removable, 4-sided, fully enclosed, galvanized sheet steel guards to OSHA standards, cleaned, factory primed and painted with yellow equipment enamel, complete with a 2-piece full length hinged front panel to permit belt maintenance or replacement without removing guard, and 40 mm (1-1/2") diameter tachometer openings at each shaft location.
- .2 For flexible couplings – removable "U" shaped galvanized steel guards to OSHA Standards with a 2.3 mm (3/32") thick frame and expanded mesh face.
- .3 For unprotected fan inlets and outlets – unless otherwise specified, removable 20 mm (3/4") galvanized steel wire mesh with galvanized steel frames, all to OSHA Standards.

2.10 Electric Motors

- .1 Unless otherwise specified, motors are to conform to NEMA Standard MG1, applicable IEEE Standards, and applicable CSA C22.2 Standards, and are to meet NEMA standards for maximum sound level ratings under full load. Confirm motor voltages prior to ordering.
- .2 Vertically mounted and submersible motors are to be purposely designed for mounting in this attitude.
- .3 Efficiency of 1-phase motors to 1 HP is to be in accordance with CAN/CSA C747. Efficiency of 3-phase motors 1 HP and larger is to be in accordance with CAN/CSA C390 or IEEE 112B.

- .4 Unless otherwise specified, 1-phase motors smaller than ½ HP are to be 115 volt, continuous duty capacitor start type with an NEMA 48 or 56 frame size, solid base, heavy-gauge steel shell with solid die-cast end shields, dynamically balanced die-cast rotor, integral automatic reset thermal overload protection, Class "B" insulation, and a 1.15 service factor at 40°C (105°F) ambient temperature.
- .5 Explosion-proof 1-phase motors are to be totally enclosed, fan cooled, 115 volt continuous duty capacitor start type in accordance with CSA C22.2 No. 145, as specified for standard 1-phase motors but suitable for use in Class 1 Group D hazardous locations and complete with a rolled steel shell and a 1.0 service factor at 40°C (105°F) ambient temperature.
- .6 Unless otherwise specified, motors ½ HP and larger are to be totally enclosed, fan cooled, 3-phase, T-frame, squirrel cage continuous duty induction motors suitable for voltages indicated on Drawings, NEMA Design "B" for normal starting torque or Design "C" for high starting torque as required by the application, each complete with Class "B" insulation, a 1.15 service factor at 40°C ambient temperature, grease lubricated open ball bearings with grease fittings to permit re-lubrication without dismantling motor, a cast iron frame with cast iron feet where required, cast iron end bracket and precision machined bearing fit, and balanced carbon steel shaft assembly with die-cast aluminum rotor windings.
- .7 Explosion-proof 3-phase motors are to be totally enclosed fan cooled motors in accordance with CSA C22.2 No. 145, generally as specified above for standard 3-phase motors but suitable for use in Class 1 Group D hazardous locations and with a 1.0 service factor at 40°C (105°F) ambient temperature.
- .8 Motor(s) for 2-speed cooling tower(s) are to be as specified above but 2-speed single winding type.
- .9 Motor(s) for 2-speed fan(s) are to be as above but 2-speed double winding type.
- .10 Unless otherwise indicated, motors 30 HP and larger are to be complete with a heat sensing PTC thermistor in the end turn of stator winding for each phase and connected in series inside motor with 2 marked leads brought out to motor conduit box.
- .11 Motors for equipment with variable frequency drives are to be generally as specified above but inverter duty type to NEMA Standard MG-1 Part 31, quantified by CSA for operation from a variable frequency drive of type specified, and complete with Class "H" insulation. Motors are to be equipped with AEGIS, or approved equal, shaft grounding ring system to protect bearings from damage by diverting harmful shaft voltages and bearing currents to ground.
- .12 Motors 150 HP and larger with "wye-delta" reduced voltage starters are to be complete with six leads for connection to motor starter.
- .13 Motors for equipment which is scheduled or specified with a corrosion resistant coating or constructed from corrosion resistant materials are to be factory coated with a primer and epoxy paint finish.
- .14 Acceptable manufacturers are:
 - .1 TECO-Westinghouse Motors (Canada) Inc.;
 - .2 Canadian General Electric;
 - .3 Baldor Electric Co.;
 - .4 U.S. Electrical Motors;
 - .5 Weg Electric Corp.;
 - .6 Marathon Electric;
 - .7 Toshiba Corp.;
 - .8 Leeson Canada.

2.11 Motor Starters and Accessories

- .1 Motor starters must be capable of starting associated motors under the imposed loads. Confirm starter voltage matches motor prior to ordering.
- .2 Unless otherwise specified, starters for 1-phase motors are to be 115 volt, thermal overload protected manual starting switches with a neon pilot light, a surface or recessed enclosure to suit the application, and, where automatic operation is required, a separate H-O-A switch in an enclosure to match starter enclosure.
- .3 Unless otherwise specified, starters for 3-phase motors less than 50 HP are to be combination "quick-make" and "quick-break" fused disconnects and full voltage non-reversing across-the-line starters, each complete with and overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.
- .4 Unless otherwise specified, starters for 3-phase motors 50 HP to 150 HP are to be reduced voltage, non-reversing, auto-transformer type starters complete with one overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.
- .5 Unless otherwise specified, starters for 3-phase motors 150 HP and larger are to be reduced voltage, non-reversing, closed transition "wye-delta" starters complete with one overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.
- .6 Starters for 2-speed double winding motors are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.
- .7 Starters for 2-speed single winding motors are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.
- .8 Starters for reversible motors for cooling towers are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to allow fan(s) to coast down to a stop before being operated in reverse rotation.
- .9 Unless otherwise specified, motor starter enclosures are to be in accordance with following NEMA ratings:
 - .1 enclosures located in sprinklered areas – Type 2;
 - .2 enclosures exposed to the elements – Type 3R, constructed of stainless steel;
 - .3 enclosures inside the building in wet areas – Type 3R, constructed of stainless steel;
 - .4 enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application;
 - .5 enclosures except as noted above – Type 1;
 - .6 enclosures located in finished areas – as above but recess type with brushed stainless steel faceplate.
- .10 Motor control centres are to be multi-unit, 2.28 m (9') high, NEMA Class 1, type "B", factory assembled, dead front, floor mounted, free-standing motor control centre with tin plated copper bus and an NEMA Type 1 or Type 2 enclosure as for loose starters specified above. Each motor control centre is to be complete with starters as specified above, load and control wiring terminal boards, and required facilities for line and load side power wiring connections.
- .11 Disconnect switches for motor control centres are to be heavy-duty, CSA certified, front operated switches as per motor starter schedule, each complete with a handle suitable for padlocking in "off" position and arranged so that door cannot be opened with handle in "on" position and an NEMA enclosure as specified for loose starters. Fusible units are to be complete with fuse clips to suit fuse types specified below.
- .12 Fuses are to be, unless otherwise scheduled or specified, 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.

- .13 Acceptable manufacturers are:
 - .1 Rockwell Automation Inc. - Allen-Bradley;
 - .2 Eaton Corp. – Cutler-Hammer;
 - .3 Eaton Corp. – Moeller Electric;
 - .4 Siemens Canada;
 - .5 Schneider Electric.

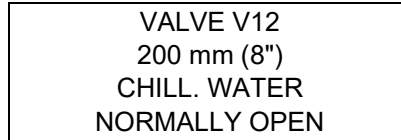
2.12 Sprinkler Proofing

- .1 Provide drip shields for protection of surface mounted equipment enclosures from water spray and dripping of liquids. Features of shields include:
 - .1 factory constructed by respective equipment manufacturers;
 - .2 constructed from non-combustible materials (sheet steel);
 - .3 enamel painted to match equipment;
 - .4 surfaces and edges filled/sanded smooth prior to painting;
 - .5 supported from equipment with structural steel rods/metal framing or other method approved by Consultant;
 - .6 structural support finish painted to match shield.
- .2 Include with equipment shop drawings, detailed dimensions of drip shields and methods of supporting.
- .3 Equipment with top cable/conduit entries to include additional sealing of entries with gasketing and/or waterproof sealant to prevent water from entering enclosure.
- .4 Design ventilation louvers such that live components are not exposed to water spray and dripping liquids.
- .5 Above requirements are additional minimum "sprinkler proof" standards for equipment specified as NEMA 1, 2 or 12.
- .6 Obtain CSA approval where required by local governing authorities.

2.13 Mechanical Work Identification Materials

- .1 Confirm with the Owner if an existing mechanical work identification system is in place and, if so, match accordingly.
- .2 If an existing mechanical work identification system is not in place, the following is to be used:
 - .1 Equipment nameplates are to be minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2-½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:
 - .1 unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved wording to completely identify equipment and its use with no abbreviations;
 - .2 wording is generally to be as per drawings, i.e. Fan EF-1, and is to include equipment service and building area/zone served, but must be reviewed prior to engraving;
 - .3 supply stainless steel screws for securing nameplates in place;

- .4 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 Valve tags are to be coloured, 40 mm (1-½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:



- .3 Standard pipe identification is to be equal to Smillie McAdams Summerlin Ltd., Brady or Primark Manufacturing Inc. vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:
 - .1 for pipe less than or equal to 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around pipe or pipe insulation;
 - .2 for pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.
- .4 Identification wording and colours for pipe identification materials are to be as follows:

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
domestic cold water	green	DOM. COLD WATER
domestic hot water supply	green	DOM. HW SUPPLY
domestic hot water recirculation	green	DOM. HW RECIRC.
tempered domestic water	green	TEMP. DOM. WATER
chilled drinking water	green	CH. DRINK WTR.
storm drainage	green	STORM
sanitary drainage	green	SAN.
plumbing vent	green	SAN. VENT
fire protection standpipe	red	F.P. STANDPIPE
fire protection sprinklers	red	F.P. SPRINKLER
natural gas	to Code	to Code, c/w pressure
natural gas vent	to Code	to Code
propane gas	to Code	to Code, c/w pressure
propane gas vent	to Code	to Code
heating water supply	yellow	HTG. WTR. SUPPLY
heating water return	yellow	HTG. WTR. RETURN
heating water drain	yellow	HTG. WTR. DRAIN
glycol heating supply	yellow	GLY. HTG. SUPPLY
glycol heating return	yellow	GLY. HTG. RETURN
glycol heating drain	yellow	GLY. HTG. DRAIN

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
glycol heat reclaim return	yellow	GLY. HTG. RECLAIM R.
glycol heat reclaim supply	yellow	GLY. HTG. RECLAIM S.
heat pump geothermal loop – source side supply	green	GEO. LOOP SOURCE SUPPLY
heat pump geothermal loop – source side return	green	GEO. LOOP SOURCE RETURN
heat pump geothermal loop – load side supply	green	GEO. LOOP LOAD SUPPLY
Heat pump geothermal loop – load side return	green	GEO. LOOP LOAD RETURN
condenser water supply	green	COND. WTR. SUPPLY
condenser water return	green	COND. WTR. RETURN
chilled water supply	green	CH. WTR. SUPPLY
chilled water return	green	CH. WTR. RETURN
chilled water drain	green	CH. WTR. DRAIN
pumped condensate	yellow	PUMPED CONDENSATE
refrigerant suction	yellow	REFRIG. SUCTION
refrigerant liquid	yellow	REFRIG. LIQUID
refrigerant hot gas	yellow	REFRIG. HOT GAS
control air	green	CONTROL AIR

.5 Colours for pipe identification legends and directional arrows are to be as follows:

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
yellow	black
green	white
red	white

.6 Duct identification is to be custom made Mylar stencils with 50 mm (2") high lettering to accurately describe duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with lettering background.

2.14 Flexible Connectors

.1 Double wall stainless steel flexible connectors for piping connections to vibration isolated equipment, each selected by manufacturer to suit the application. Shop drawings or product data sheets must indicate construction and performance requirements that suit the application. Acceptable manufacturers are:

- .1 Hyspan Precision Products Inc.;
- .2 Senior Flexonics Ltd.;
- .3 The Metraflex Co.

3 Execution

3.01 General Piping and Ductwork Installation Requirements

- .1 Unless otherwise specified, locate and arrange horizontal pipes and ducts above or at ceiling on floors, arranged so that under consideration of all other work in area, maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, with Consultant's approval.
- .2 Unless otherwise specified, install work concealed in finished spaces, and concealed to degree possible in partially finished and unfinished spaces. Refer to and examine Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Walls which are painted are considered finished.
- .3 Install pipes and ducts parallel to building lines and to each other.
- .4 Neatly group and arrange exposed work.
- .5 Locate work to permit easy access for service or maintenance as required and/or applicable. Locate valves, dampers and any other equipment which will or may need maintenance or repairs and which are to be installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate accessories at floor level.
- .6 Make connections between pipes of different materials using adapters suitable for application. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.
- .7 Comply with equipment and material manufacturer's installation instructions unless otherwise specified herein or on drawings, and unless such instructions contradict governing codes and regulations.
- .8 Carefully clean ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.
- .9 Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around pipe or duct, except for ductwork at fire barriers, in which case insulation will be terminated at each side of the duct fire damper.
- .10 Inspect surfaces and structure prepared by other trades before performing work. Verify surfaces or structure to receive work has no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of work will constitute acceptance of such surfaces as being satisfactory.
- .11 Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both, is to be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean piping prior to being concealed.
- .12 For factory applied finishes, repaint or refinish surfaces damaged during shipment and installation. Quality of repair work is to match original finish. This requirement also applies to galvanized finishes.
- .13 Where mechanical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminium ductwork, copper or stainless steel pipe, etc.
- .14 Provide screwed unions or flanges in piping connections to equipment and in regular intervals in long (in excess of 12 m [40']) piping runs to permit removal of sections of piping.
- .15 Unless otherwise specified and except where space limitations do not permit, piping elbows are to be long radius. Eccentric reducers are to be installed with straight side at top of piping.

3.02 Pipe Joint Requirements

- .1 Do not make pipe joints in walls or slabs.

- .2 Ream piping ends prior to making joints.
- .3 Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After pipe has been screwed into fitting, valve, union, or piping accessory, not more than 2 pipe threads are to remain exposed.
- .4 Site bevel steel pipe to be welded or supply mill bevelled pipe. Remove scale and oxide from bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.
- .5 Welded joints are to be made by CWB certified licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed. Each weld is to be identified with the welder's identification symbol, and welds are not to be concealed until they have been inspected and approved. Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.
- .6 Unless otherwise specified, make flanged joints with Garlock 5500 or equivalent gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than length necessary to screw nut up flush to the end of bolt. Bolts used for flanged connections in piping with a working pressure of 690 kPa (100 psi) and greater are to be ASTM A-193 Grade B-7, with heavy hexagon nuts to ASTM A-194 CL-2H. Provide suitable washers between each bolt head and flange and between each nut and flange.
- .7 A random check of bolted flanged connections will be made to verify flanged connections are properly mated with no shear force acting on bolts. Supply labour to disconnect and reconnect selected flanged joints. If improperly mated joints are found, remove and reinstall affected piping so flanges mate properly. If improperly mated joints are found, additional joints will be checked, and you will be responsible for the repair of any other improper joints discovered.
- .8 Unless otherwise specified make soldered joints in copper piping using flux suitable for and compatible with type of solder being used. Clean the outside of pipe end and inside of fitting, valve, or similar accessory prior to soldering.
- .9 Install mechanical joint fittings and couplings in accordance with manufacturer's instructions.
- .10 Grooves are to be rolled. Make arrangements with coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to manufacturer's instructions with respect to pipe grooving, support, type of gasket required, anchoring and guiding the grooved piping system.
- .11 If pressure crimped couplings and fittings are used, ensure gaskets are fully compatible with piping fluid, and valves and piping accessories are suitable. Use only fitting manufacturer supplied crimping equipment. Comply with manufacturer's latest published specification, instructions, and recommendations with respect to pipe, coupling, and fitting preparation and installation, and support, anchoring and guiding of the piping system.
- .12 Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with manufacturer's recommendations, ASTM D2855, and CSA requirements.
- .13 Install PVC piping with gasketed joints in accordance with manufacturer's current published specifications, instructions and recommendations, and CSA requirements.

3.03 Installation of Pipe Sleeves

- .1 Where pipes pass through concrete and/or masonry surfaces provide pipe sleeves as follows:
 - .1 in poured concrete slabs – unless otherwise specified, minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves;
 - .2 in concrete or masonry walls – Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe.
- .2 Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with a waterstop plate in accordance with drawing detail. Provide waterproof sleeves in following locations:

- .1 in mechanical room floor slabs, except where on grade;
 - .2 in slabs over mechanical, fan, electrical and telephone equipment rooms or closets;
 - .3 in floors equipped with waterproof membranes;
 - .4 in roof slab;
 - .5 in waterproof walls.
- 3 Size sleeves, unless otherwise specified, to leave 12 mm ($\frac{1}{2}$ ") clearance around pipes, or where pipe is insulated, a 12 mm ($\frac{1}{2}$ ") clearance around pipe insulation.
 - 4 Pack and seal void between pipe sleeves and pipe or pipe insulation in non-fire rated construction for the length of sleeves as follows:
 - .1 pack sleeves in interior construction with mineral wool and seal both ends of sleeves with non-hardening silicone base caulking compound;
 - .2 pack sleeves in exterior walls above grade with mineral wool and seal both ends of sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified;
 - .3 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.
 - 5 Where sleeves are required in masonry work, accurately locate and mark sleeve location, and hand sleeves to mason for installation.
 - 6 Terminate piping for sleeves that will be exposed so sleeve is flush at both ends with building surface so sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above finished floor.
 - 7 "Gang" type sleeving will not be permitted.
 - 8 Where sleeves are provided in non-fire rated construction for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of sleeved opening.

3.04 Installation of Waterproof Mechanical Seals

- .1 Provide watertight link type mechanical seals in exterior wall openings.
- .2 Assemble and install each mechanical seal in accordance with manufacturer's instructions.
- .3 After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until seal is completely watertight.

3.05 Duct Openings

- .1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by trade responsible for particular construction in which opening is required.
- .2 Size openings for fire dampers to 600 mm (24") high to suit damper arrangement with folding blade out of air stream.
- .3 For duct openings except where fire dampers are required, pack and seal space between duct or duct insulation and duct opening as specified above for pipe openings in non-fire rated construction.

3.06 Sleeve and Formed Opening Location Drawings

- .1 Prepare and submit for review, drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.
- .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.
- .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

3.07 Installation of Pipe Escutcheon Plates

- .1 Provide escutcheon plates suitably secured over exposed piping 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 plates so they are tight against building surface concerned, completely covering pipe sleeves and/or openings, except where waterproof sleeves extend above floors, in which case fit plate tightly around sleeve.

3.08 Installation of Fastening and Securing Hardware

- .1 Provide fastening and securing hardware required for mechanical work to maintain installations attached to structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding dead loads, live loads, superimposed dead loads, and any vibration of 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 floor, wall or ceiling construction is not suitable to support loads, provide additional framing or special fasteners to ensure proper securement to structure that is to support the products. Provide reinforcing or connecting supports where required to distribute loading to structural components.
- .4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CAN/CSA Z166.1 and CAN/CSA Z166.2.
- .5 Do not attach fasteners to steel deck without written consent from Consultant.

3.09 Installation of Pipe Hangers and Supports

- .1 Provide required pipe hangers and supports.
- .2 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from structure only.
- .3 For insulated pipe, size hanger or support to suit diameter of insulated pipe and install hanger or support on outside of insulation and insulation finish.
- .4 Support requirements for underground piping are as follows:
 - .1 support underground pipe, unless otherwise specified, on a well compacted bed of dry, natural, undisturbed earth free from rocks or protrusions of any kind, or on compacted material as specified;
 - .2 support underground service piping penetrating building exterior walls or foundations to prevent pipe damage if minor building settlement occurs;
 - .3 ensure bedding and supports for underground pipes are flat and true and allowances are made for pipe hubs, couplings, or other protrusions so no voids are left between pipe and bedding.

- .5 Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe less than or equal to 25 mm (1") dia. are to be clevis type or adjustable ring type, and hangers for suspended pipe greater than or equal to 40 mm (1-1/2") dia. are to be adjustable clevis type.
- .6 Space hangers and supports in accordance with following:
- .1 cast iron pipe – hang or support at every joint with maximum 2.4 m (8') spacing;
 - .2 plastic pipe – conform to pipe manufacturer's recommended support spacing;
 - .3 glass pipe – conform to pipe manufacturer's recommended support spacing and support requirements;
 - .4 copper and steel pipe – hang or support at spacing in accordance with following schedule:

PIPE DIA.	MAX. SPACING STEEL (meters)	MAX. SPACING COPPER (meters)
to 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1-1/2")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2-1/2")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3-1/2")	3.6 m (12')	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')
250 mm (10")	6.0 m (20')	
300 mm (12")	6.7 m (22')	

- .5 flexible grooved pipe/coupling joint piping – as above but with not less than one hanger or support between joints;
- .7 Where pipes change direction, either horizontally or vertically, provide a hanger or support on horizontal pipe not more than 300 mm (12") from elbow, and where pipes drop from tee branches, support tees in both directions not more than 50 mm (2") on each side of tee.
- .8 When pipes with same slope are grouped and a common hanger or support is used, space hanger or support to suit spacing requirement of smallest pipe in group and secure pipes in place on common hanger or support.
- .9 Provide roller hangers or supports for heat transfer piping greater than or equal to 150 mm (6") diameter and conveying a material 75°C (170°F) or greater to facilitate pipe movement due to expansion and contraction, and at each hanger or support tack weld a steel protection saddle to pipe to protect piping insulation.
- .10 Unless otherwise shown or specified, support vertical piping by means of supports specified in Part 2 of this Section, spaced in accordance with following:
 - .1 support vertical pipes at maximum 3 m (10') intervals or at every floor, whichever is lesser;
 - .2 for sections of vertical piping with a length less than 3 m (10'), support pipe at least once;
 - .3 for vertical cast iron plain end pipe (mechanical joint type), secure riser or pipe clamp around pipe under a flange integral with pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support;
 - .4 for vertical steel pipe risers in excess of 3 m (10'), weld shear lugs to pipe to carry load;

- .5 for vibration isolated piping risers, provide rubber-steel-rubber vibration isolation pads between riser clamps and floor.
- .11 Support piping on the roof as follows:
 - .1 on existing roof – provide support members as specified in Part 2 of this Section spaced as per schedule above and of a type to suit the application, and, for each support, carefully scrape away roofing gravel, bed support in a heavy covering of roofing mastic, then scrape gravel back up around support and secure pipes to supports;
 - .2 on new roof – supply manufactured roof supports as per Part 2 of this Section to accommodate piping involved and support spacing specified above, and hand supports to roofing trade on roof for installation as part of roofing work, then secure piping in place on supports.
- .12 Each hanger, support or securement for horizontal bare copper tubing is to be plastic coated to prevent direct contact between pipe and ferrous hanger. Each wall or floor clamp for vertical bare copper piping is to be isolated from pipe by means of strips of flexible rubber inserts. Use of painted ferrous hangers and supports, including those painted with copper coloured paint, is not acceptable. Site application of tape or other types of isolation is not acceptable.
- .13 For insulated horizontal piping less than or equal to 40 mm (1-1/2") diameter, provide galvanized steel insulation protection shields between insulation and hanger or support. Install shields immediately after pipe is insulated.
- .14 Do not support piping from steel deck without written consent from Consultant.

3.10 Supply of Access Doors

- .1 Supply access doors to give access to mechanical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on drawings.
- .2 Before commencing installation of mechanical work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange mechanical work to suit.
- .3 Access doors will be installed by trade responsible for particular type of construction in which doors are required. Supply access doors to trade installing same at proper time.
- .4 Wherever possible, access doors to be of a standard size for each application. Confirm exact dimensions and minimum size restrictions with Consultant prior to ordering.
- .5 Group piping and ductwork to ensure minimum number of access doors is required.
- .6 Coordinate with Electrical Contractor and General Trades Contractor to ensure access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and work involving both mechanical and electrical services should, where possible, be accessible from common access door. Coordinate work to ensure common location access doors are not supplied by both Mechanical Divisions and Electrical Divisions.

3.11 Installation of Valves

- .1 Generally, valve locations are indicated or specified on drawings or specified in Sections of the Specification where valves are specified, however, regardless of locations shown or specified, following requirements apply:
 - .1 provide shut-off valves to isolate systems, at base of vertical risers, in branch take-offs at mains and risers on floors, to isolate equipment, to permit work phasing as required, and wherever else required for proper system operation and maintenance;
 - .2 install shut-off valves with handles upright or horizontal, not inverted, and located for easy access;
 - .3 unless otherwise specified, provide a check valve in discharge piping of each pump;
 - .4 valve sizes are to be same as connecting pipe size;

- .5 valves are to be permanently identified with size, manufacturer's name, valve model or figure number and pressure rating, and wherever possible, valves are to be product of same manufacturer;
- .6 for valves in insulated piping, design of valve stem, handle and operating mechanism is to be such that insulation does not have to be cut or altered in any manner to permit valve operation.

3.12 Installation of Pressure Gauges and Thermometers

- .1 Provide pressure gauges in following locations where applicable:
 - .1 in valved tubing across suction, suction strainer (if applicable), and discharge piping of each circulating pump;
 - .2 in supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.;
 - .3 in expansion tank(s);
 - .4 in separate domestic hot water storage tank(s);
 - .5 at top most outlet in each standpipe fire protection system riser;
 - .6 in piping at each side of a pressure reducing valve;
 - .7 in potable water service piping downstream of meter;
 - .8 wherever else shown and/or specified.
- .2 Provide thermometers in following locations where applicable:
 - .1 in supply and return piping connections to main mechanical plant equipment such as boilers, chillers, cooling towers, heat exchangers, main coils, etc., unless temperature indication is supplied with equipment;
 - .2 wherever else shown and/or specified.
- .3 Conform to following installation requirements where applicable:
 - .1 for installation of thermometers in piping wells, provide a coat of metallic base heat transfer paste or grease in piping well;
 - .2 for pressure gauges in piping at equipment locations, install pressure gauge between equipment and first pipe fitting;
 - .3 locate, mount and adjust instruments so they are easily readable;
 - .4 where pressure gauges and/or thermometers are located at high level or in an area where they cannot be easily seen, provide remote reading instruments.

3.13 Installation of Equipment Drive Guards and Accessories

- .1 Provide OSHA guards for exposed accessible rotating parts such as belt drives, couplings, fan wheels, and shaft ends on mechanical equipment.
- .2 Install belt guards to allow movement of motors for adjusting belt tension.
- .3 Provide a means to permit lubrication and use of test instruments with guards in place.
- .4 Secure guards to equipment or equipment base but do not bridge sound or vibration isolation.
- .5 Where equipment oil level gauges, oil reservoirs, grease cups, or grease gun fittings are integral with equipment but are not easily accessible for service, extend to an accessible location using aluminium or copper tubing.

3.14 Mechanical Work Identification

- .1 Identify new exposed piping and ductwork as per Part 2 of this Section in locations as follows:
 - .1 at every end of every piping or duct run;
 - .2 adjacent to each valve, strainer, damper and similar accessory;
 - .3 at each piece of connecting equipment;
 - .4 on both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified;
 - .5 at 6 m (20') intervals on pipe and duct runs exceeding 6 m (20') in length;
 - .6 at least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.
- .2 Unless otherwise specified identify new concealed piping and ductwork as per Part 2 of this Section in locations as follows:
 - .1 at points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas;
 - .2 at maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room;
 - .3 at each access door location;
 - .4 at each piece of connected equipment, automatic valve, etc.
- .3 Provide an identification nameplate for equipment provided as part of this project, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate nameplates in the most conspicuous and readable location.
- .4 Paint new natural and/or propane gas piping with primer and 2 coats of yellow paint in accordance with Code requirements. Identify piping at intervals as specified above.
- .5 Provide an identification 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 provided as part of mechanical work, and on each disconnect switch provided as part of the electrical work for motorized equipment provided as part of mechanical work.
- .6 For electrically traced mechanical work, identification wording is to include "ELECTRICALLY TRACED".
- .7 Tag valves and prepare a valve tag chart in accordance with following requirements:
 - .1 attach a valve tag to each new valve, except for valves located immediately at equipment they control;
 - .2 prepare a digital valve tag chart to list tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed);
 - .3 if an existing valve tag chart is available at site, valve tag numbering is to be an extension of existing numbering and new valve tag chart is to incorporate existing chart;
 - .4 include a copy of valve tag chart in each copy of operating and maintenance instruction manuals.
- .8 Where shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in ceiling panel material, or stickers equal to Brady "Quick Dot" on ceiling grid material to indicate locations of items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:
 - .1 HVAC piping valves and equipment: yellow

- .2 fire protection valves and equipment: red
- .3 plumbing valves and equipment: green
- .4 HVAC ductwork dampers and equipment: blue
- .5 control system hardware and equipment: orange

3.15 Finish Painting of Mechanical Work

- .1 Finish paint exposed mechanical work as specified and/or scheduled in accordance with requirements of Division 09.
- .2 Touch-up paint damaged factory applied finishes on mechanical work products.

3.16 Pipe Leakage Testing

- .1 Before piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test piping for leakage.
- .2 Tests are to be witnessed by Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.
- .3 When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.
- .4 Gravity Drainage and Vent Piping
 - .1 Test piping in accordance with local governing building code.
 - .2 After fixtures and fittings are set and pipes are connected to building drain or drains, turn on water into pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Perform a smoke test if required by local governing authorities.
- .5 Pumped Drainage Piping
 - .1 Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for a minimum of 2 hours.
- .6 Domestic Water Piping
 - .1 Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for a minimum of 2 hours.
- .7 Sprinkler System Piping
 - .1 Test system piping in accordance with requirements of NFPA No. 13, "Installation of Sprinkler Systems", and in accordance with any additional requirements of governing authorities.
- .8 Standpipe System Piping
 - .1 Test system piping in accordance with requirements of NFPA No. 14, "Standpipe and Hose Systems", and in accordance with any additional requirements of governing authorities.
- .9 Heat Transfer (HVAC) System Piping
 - .1 Test piping with cold water at a pressure of 1035 kPa (150 psi) for a minimum of 2 hours.
- .10 Natural Gas Piping

- .1 Test piping in accordance with requirements of CAN/CSA B149.1 and any additional requirements of local governing authorities.
 - .2 After completion of the verification test, locate required tag stating results of the verification test at the point of entry of gas main into building, affixed to the pipe in a secure manner.
 - .3 Check piping joints and connections for leaks with a water/soap solution while piping is under pressure.
- .11 Propane Gas Piping
- .1 Test piping in accordance with requirements of CAN/CSA B149.2 and any additional requirements of local governing authorities.
 - .2 After completion of the verification test, locate required tag stating results of the verification test at the point of entry of gas main into building, affixed to the pipe in a secure manner.
 - .3 Check piping joints and connections for leaks with a water/soap solution while piping is under pressure.
- .12 Refrigerant Piping
- .1 Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of ASHRAE Handbook - Fundamentals.
- .13 Control Air Piping and Tubing
- .1 Test control air piping and tubing with dry compressed air or nitrogen before concealing and again before connection of instruments.
 - .2 Rough-in test pressure is to be 345 kPa (50 psi) maintained over 24 hours with a pressure drop not to exceed 35 kPa (5 psi).
 - .3 Test joints for leaks with a soap solution.
 - .4 Finish test is to be 205 kPa (30 psi) with a permissible loss of 7 kPa (1 psi) over a 4 hour period. Prior to connecting instruments, blow systems clean and dry, and test component connections for leaks with a water/soap solution.
- .14 Following requirements apply to all testing:
- .1 ensure piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing;
 - .2 temporarily remove or valve off piping system specialties or equipment which may be damaged by test pressures prior to pressure testing systems, and flush piping to remove foreign matter;
 - .3 when testing is carried out below highest level of the particular system, increase test pressure by the hydrostatic head of 7 kPa (1 psi) for every 600 mm (24") below the high point;
 - .4 include for temporary piping connections required to properly complete tests;
 - .5 piping under test pressure is to have zero pressure drop for length of test period;
 - .6 make tight leaks found during tests while piping is under pressure, and if this is impossible, remove and refit piping and reapply test until satisfactory results are obtained;
 - .7 where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions;
 - .8 tests are to be done in reasonably sized sections so as to minimize number of tests required;

- .9 in addition to leakage tests specified above, demonstrate proper flow throughout systems including mains, connections and equipment, as well as proper venting and drainage, and include for any necessary system adjustments to achieve proper conditions.

3.17 Supply of Motor Starters and Accessories

- .1 Unless otherwise shown or specified, supply a starter for each item of motorized equipment. Refer to Motor Starter Schedule.
- .2 Where 3-phase starters are indicated in motor control centres, supply motor control centres with starters and bolt to a concrete housekeeping pad.
- .3 Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with equipment is fed from a motor control centre, provide a disconnect switch in motor control centre in lieu of a motor starter.
- .4 Where 3-phase starters are indicated and/or scheduled to be mounted on a motor starter panel, starters will be mounted and connected, complete with panels and splitter trough, as part of electrical work. Hand starters to electrical trade at site when they are required.
- .5 Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with equipment is fed from a motor starter panel, a disconnect switch will be provided on motor starter panel as part of electrical work.
- .6 Unless otherwise specified or shown on drawings, 1-phase motor starters will be mounted adjacent to equipment they serve and connected complete as part of electrical work. Hand starters to electrical trade at site at the proper time.

3.18 Electrical Wiring Work for Mechanical Work

- .1 Unless otherwise specified or indicated, following electrical wiring work for mechanical equipment will be done as part of the electrical work:
 - .1 "line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from starters or disconnects to equipment;
 - .2 "line" side power wiring to individual wall mounted starters, and "load" side wiring from starters to equipment;
 - .3 "line" side power wiring to pre-wired power and control panels and variable frequency drives (VFD), and "load" side power wiring from the panels and VFD's to equipment;
 - .4 provision of receptacles for plug-in equipment;
 - .5 provision of disconnect switches for motors in excess of 10 m (30') from starter location, or cannot be seen from starter location, and associated power wiring;
 - .6 motor starter interlocking in excess of 24 volts;
 - .7 wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts;
 - .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 volt wiring connections to BAS system controllers/panels and other control system or component requiring 120 volt power including, but not limited to, VAV boxes, dampers, low voltage transformers, etc.

- .2 Mechanical wiring work not listed above or specified herein or on drawings to be done as part of electrical work is to be installed in conduit and is to be done as part of mechanical work in accordance with wiring requirements specified for electrical work.

3.19 Interruption to and Shut-Down of Mechanical Services and Systems

- .1 Coordinate shut-down and interruption to existing mechanical systems with Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning, unless otherwise specified in Division 01. Include for costs of premium time to perform work during nights, weekends or other times outside of normal working hours, which may be necessary to comply with stipulations specified herein this Article. Services for operation of existing non-renovated areas of building are to be maintained.
- .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 Owner and Consultant in writing 5 working days in advance of proposed shut-down or interruption and obtain written consent to proceed. Do not shut-down or interrupt any system or service without such written consent. Shutdowns of some essential services may require additional advance notification time.
- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize shut-down time and to reinstate systems as soon as possible, and, prior to any shut-down, ensure materials and labour required to complete the work for which shut-down is required are available at site.
- .5 Pipe freezing shall be used to connect new piping to existing piping. Alternative methods may be proposed, if site conditions are evaluated and permit, and are approved by the engineer.
- .6 Where existing isolation valves do not hold, pipe freezing shall be used to connect new piping to existing piping.

3.20 Equipment Bases and Supports

- .1 Unless otherwise specified or required, set floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of equipment on each side and end, or a minimum of 200 mm (8") from centreline of equipment anchor bolts to edge of the base, whichever is larger. Conform to 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 concrete pour and be responsible for required levelling, alignment, and grouting of equipment;
 - .3 as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details.
- .2 For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to following requirements:
 - .1 provide stands and supports, except those for small equipment, designed by a structural engineer registered in jurisdiction of the work, and submit stamped and signed design drawings with calculations as shop drawings for review;
 - .2 flange bolt steel stands to concrete housekeeping pads;
 - .3 seismically restrained stands and supports in accordance with applicable requirements.
- .3 Where indicated on mechanical drawings, provide welded, cleaned and prime coat painted structural steel platforms, designed by a structural engineer registered in the jurisdiction of the work, for service access to equipment. Submit stamped and signed design drawings with calculations as shop drawings for review. Conform to following requirements:
 - .1 platforms in accordance with OHS requirements and adequately sized, braced, anchored, and, as required, seismically restrained;

- .2 flooring equal to Fisher & Ludlow "Tru-Weld" Type 19-4, Borden type W/B (19-W-4), welded steel bar type grating;
- .3 support legs constructed of welded Schedule 40 black steel pipe with welded steel cross-bracing, securely anchored and sway braced;
- .4 safety guard rails, constructed from minimum 32 mm (1-¼") dia. Schedule 40 black steel pipe, for all platforms and complete with vertical stanchions at maximum 1.2 m (48") centres, top and intermediate horizontal railing, and toe plates at floor;
- .5 vertical ladders constructed of Schedule 40 black steel pipe, 25 mm (1") dia. for equal height rungs, 40 mm (1-½") for stringers, anchored to floors and walls and sway braced as required;
- .6 ships ladders, used wherever space conditions permit, of welded steel construction, climbing at an approximate 60° angle, and complete with channel iron stringers, open grate equal height risers approximately 165 mm (6-½") wide and factory made by grating manufacturer, handrails, and suitable anchoring and support.

3.21 Mechanical Service Requirements for Floating Floor Slabs

- .1 Where mechanical services are required to be installed in or through a vibration isolated floating slab, install such services so as not to transmit any vibration to base slab on which floating floor slab is placed.
- .2 Wherever possible, arrange mechanical work to avoid penetrating a floating floor slab.

3.22 Concrete Work for Mechanical Equipment Bases/Pads

- .1 Unless otherwise specified in Division 03, provide poured concrete work, including reinforcing and formwork, required for mechanical equipment bases/pads. Perform concrete work in accordance with requirements specified in Division 03.
- .2 Unless otherwise specified in Division 03, concrete is to be minimum 20,700 kPa ready-mix concrete in accordance with CAN/CSA-A23.1 and the Building Code.
- .3 Submit for review, dimensioned shop drawings, prepared and stamped by a professional structural engineer registered in the jurisdiction of the work, for concrete pads or bases for support of large, heavy equipment. Indicate on shop drawings total weight of pad or base as well as equipment it is provided for, and concrete reinforcing.
- .4 Ensure that bases and pads are keyed into the structure to meet seismic restraint requirements where applicable.

3.23 Excavation and Backfill Work

- .1 Unless otherwise specified in Division 31, provide all excavation and backfill associated with the mechanical scope of work.
- .2 Before commencement of excavation for work, determine in consultation with Consultant, Owner, Municipality and utilities, presence, if any, of existing underground services at site. Engage local utilities to locate and mark out such services. Ensure trades concerned are aware of their presence.
- .3 Be responsible for any damage done to underground services caused by neglect to determine and mark out location of such services prior to excavation work commences.
- .4 Where Work falls under jurisdiction of local governing utility, confirm requirements and comply with utility requirements.
- .5 Unless otherwise specified in Division 31, provide excavation, backfill and related work required for mechanical work. Obtain a copy of soil test report if available from Consultant. Depth of excavations must accommodate local governing requirements and local standard practices to compensate for local frost levels of Place of the Work.
- .6 Inverts and locations of existing site services may have been site surveyed and approximate location may be shown on drawings. Confirm inverts and locations are correct, prior to commencing excavation and contact Utilities to accurately locate their services. Where discrepancies are found, immediately inform Consultant, and await a direction. Grade bottom of trench excavations as required.

- .7 In firm, undisturbed soil, lay pipes directly on soil, unless otherwise directed.
- .8 Before backfilling, arrange for inspection of work by Consultant. Do not backfill work unless reviewed with Consultant. Failure to do so prior to backfilling will require re-excavating work and re-backfill at no additional cost to Owner.
- .9 Unless otherwise specified, backfill trenches within building with clean sharp sand in individual layers of maximum 150 mm (6") thickness compacted to a density of 100% Standard Proctor. Hand compact first layers up to a compacted level of minimum 300 mm (12") above top of pipe. Hand or machine compact the balance up to grade.
- .10 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 pipe, 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.
- .11 Unless otherwise specified, backfill trenches outside 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.
- .12 Provide minimum 1.37 m (4.5') of cover for underground piping subject to freezing and located outside building.
- .13 Provide minimum 450 mm (18") of cover for underground piping subject to freezing and located inside building.
- .14 After first lift of backfill has been compacted, mark entire path of pipe using continuous 75 mm (3") wide detectable identified marking tape equal to SMS Ltd. D-UGMT.
- .15 Unless otherwise directed in Division 02 and/or Division 31, store and dispose of excavated materials as follows:
 - .1 during progress of contract, place material as directed in such a manner to minimize damage or disfigurement of ground and which in no way impedes progress of work;
 - .2 separately place surplus topsoil and subsoil as directed; leave site clean and unencumbered.
- .16 Perform pumping as required to keep excavations free of water.
- .17 Engage services of independent soils testing agency to test final backfill compaction density of each backfilled location. Compact backfill to satisfaction of testing agency and in accordance with Specification. Submit a copy of testing agency's report to Consultant for review.
- .18 Fill depressions to correct grade level with appropriate material, after an adequate period has passed to reveal any settlement. Use maximum possible compaction. Pay costs required to make good damages caused by settlement.
- .19 Coordinate requirements for final surface toppings (concrete, asphalt, pavers, grass sod, etc.) with General Contractor.

3.24 Cutting, Patching and Core Drilling

- .1 Unless otherwise provided by General Trades, perform cutting, patching, and core drilling of existing building required for installation of mechanical work. Perform cutting in a neat and true fashion, with proper tools and equipment to Consultant's approval. Patching is to exactly match existing finishes and be performed by tradesmen skilled in particular trade or application. Work is subject to review and acceptance by Consultant.
- .2 Criteria for cutting holes for additional services:
 - .1 cut holes through slabs only; no holes to be cut through beams;
 - .2 cut holes 150 mm (6") diameter or smaller only; obtain approval from Structural Consultant for larger holes;
 - .3 keep at least 100 mm (4") clear from beam faces;
 - .4 space at least 3 hole diameters on centre;

- .5 for holes that are required closer than 25% of slab span from supporting beam face, use cover meter above slab to clear slab top bars;
- .6 for holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars;
- .7 submit sleeving drawings indicating holes and their locations for Structural Consultant's review.
- 3 Do not cut or drill any existing work without approval from Owner and Consultant. Be responsible for damage done to building and services caused by cutting or drilling.
- 4 Where pipes pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around pipes or pipe insulation.
- 5 Prior to drilling or cutting an opening, determine, in consultation with Consultant and Owner, and by use of non-destructive radar scan (magnetic scan) of slab or wall, presence of any existing services and reinforcement bars concealed behind building surface to be cut and locate openings to suit. Coring is not permitted through concrete beams or girders.
- 6 Where drilling is required in waterproof slabs, size opening to permit snug and tight installation of a pipe sleeve sized to leave 12 mm (½") clearance around pipe or pipe insulation. Provide a pipe sleeve, constructed of Schedule 40 galvanized steel pipe with a flange at one end and of a length to extend 100 mm (4") above slab, in opening. Secure flange to the underside of slab and caulk void between sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.
- 7 Firestop and seal openings in fire rated construction. Do not leave openings open overnight unless approved by Owner and Consultant.

3.25 Packing and Sealing Core Drilled Pipe Openings

- .1 Pack and seal void between pipe opening and pipe or pipe insulation for length of opening as follows:
 - .1 non-fire rated interior construction – pack with mineral wool and seal both ends of opening with non-hardening silicone base caulking compound to produce a water-tight seal;
 - .2 exterior walls above grade – pack with mineral wool and seal both ends of sleeves water-tight with non-hardening silicone base caulking compound unless mechanical type seals have been specified;
 - .3 exterior walls below grade (and any other wall where water leakage may be a problem) – seal with link type mechanical seals as specified.

3.26 Flashing for Mechanical Work Penetrating Roof

- .1 Unless otherwise specified in Division 07, perform required flashing work, including counter-flashing, for mechanical work penetrating and/or set in roof.
- .2 Perform flashing work in accordance with requirements of drawing details and/or requirements specified in Division 07.

3.27 Cleaning Mechanical Work

- .1 Refer to cleaning requirements specified in Division 01.
- .2 Clean mechanical work prior to application for Substantial Performance of the Work.
- .3 Include for vacuum cleaning interior of air handling units and ductwork systems.

3.28 Connections to Other Equipment

- .1 Carefully examine Contract Documents during bidding period and include for mechanical work piping and/or ductwork connections to equipment requiring such connections.

3.29 Seismic Restraint Anchor Points for Equipment

- .1 Where mechanical equipment requires seismic restraint, it is to be complete with manufacturer designed and rated seismic restraint anchor points and attachments, certified by equipment manufacturers, so equipment may be bolted down or restrained in the field.
- .2 Equipment to be restrained must be designed such that the strength and anchorage of the internal components of equipment exceeds force level used to restrain and anchor equipment itself to the supporting structure.

3.30 Installation of Flexible Connectors

- .1 Provide flexible connectors in piping connections to seismically restrained equipment, where applicable, and wherever else shown.
- .2 Provide flexible connectors in piping connections to vibration isolated equipment.

3.31 Fan Noise Levels

- .1 Submit sound power levels with fan shop drawings/product data, with levels measured to AMCA 300 and calculated to AMCA 301.

3.32 Equipment and System Manufacturer's Certification

- .1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for equipment/system manufacturer's authorized representative to visit site to examine installation, and after any required corrective measures have been made, to certify in writing to Consultant that equipment/system installation is complete and in accordance with equipment/system manufacturer's instructions.

3.33 Equipment and System Start-Up

- .1 When installation of equipment/systems is complete but prior to commissioning, perform start-up for equipment/systems as specified in mechanical work Sections in accordance with following requirements:
 - .1 submit a copy of each equipment/system manufacturer's start-up report sheet to Consultant for review, and incorporate any comments made by Consultant;
 - .2 under direct on-site supervision and involvement of equipment/system manufacturer's representative, start-up equipment/systems, make any required adjustments, document procedures, leave equipment/systems in proper operating condition, and submit to Consultant complete set of start-up documentation sheets signed by manufacturer/supplier and Contractor.

End of Section

1 General

1.01 Section Includes

- .1 This Section specifies requirements, criteria, methods and execution for mechanical demolition work that are common to one or more mechanical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

2 Products – Not Used

3 Execution

3.01 Disconnection and Removal of Existing Mechanical Work

- .1 Where indicated on drawings, disconnect and remove existing mechanical work, including hangers, supports, insulation, etc. Disconnect at point of supply, remove obsolete connecting services and make system safe. Cut back obsolete piping behind finishes and cap water-tight unless otherwise specified.
- .2 Scope and extent of demolition or revision work is only generally indicated on drawings. Estimate scope, extent and cost of work at site during bidding period site visit(s). Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at site during bidding period site visits will not be allowed.
- .3 If any re-design is required due to discrepancies between mechanical drawings and site conditions, notify Consultant who will issue a Site Instruction. If, in the opinion of Consultant, discrepancies between mechanical drawings and actual site conditions are of a minor nature, required modifications are to be done at no additional cost.
- .4 Where existing mechanical services extend through, or are in an area to serve items which are to remain, maintain services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during renovation work, so as to be concealed behind new or existing finishes.
- .5 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused.

3.02 Roofing Work

- .1 Where roof revisions and/or replacements are part of project, include for disconnecting, lifting, or temporarily removing mechanical equipment on roof as required to permit completion of roofing work, and for re-installing equipment when roofing work is complete.

End of Section

1 General

1.01 References

- .1 Division 00 and Division 01 apply to and are a part of this Section.

1.02 Application

- .1 This Section specifies requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. Where requirements of this Section contradict requirements of Divisions 00 or 01, conditions of Division 00 or Division 01 to take precedence.
- .2 Be responsible for advising product vendors of requirements of this Section.

1.03 Definitions

- .1 "concealed" – means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.
- .2 "exposed" – means work normally visible, including work in equipment rooms, service tunnels, and similar spaces.
- .3 "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished.
- .4 "provision" or "provide" (and tenses of "provide") – means supply and install complete.
- .5 "install" (and tenses of "install") – means secure in position, connect complete, test, adjust, verify and certify.
- .6 "supply" – means to procure, arrange for delivery to site, inspect, accept delivery and administer supply of products; distribute to areas; and include manufacturer's supply of any special materials, standard on site testing, initial start-up, programming, basic commissioning, warranties and manufacturers' assistance to Contractor.
- .7 "delete" or "remove" (and tenses of "delete" or "remove") – means to disconnect, make safe, and remove obsolete materials; patch and repair/finish surfaces to match adjoining similar construction; include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Owner and reviewed with Consultant.
- .8 "BAS" – means building automation system; "BMS" – means building management system; "FMS" – means facility management system; and "DDC" means direct digital controls; references to "BAS", "BMS", "FMS" and "DDC" generally mean same.
- .9 "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" – means government departments, agencies, standards, rules and regulations that apply to and govern work and to which work must adhere.
- .10 "OSHA" and "OHSA" – stands for Occupational Safety and Health Administration and Occupational Health and Safety Act, and wherever either one is used, they are to be read to mean local governing occupational health and safety regulations that apply to and govern work and to which work must adhere, regardless if Project falls within either authority's jurisdiction.
- .11 "Mechanical Divisions" – refers to Divisions 20, 21, 22, 23, 25 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Mechanical Contractor, unless otherwise noted.
- .12 "Electrical Divisions" – refers to Divisions 26, 27, 28 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Electrical Contractor, unless otherwise noted.
- .13 "Consultant" – means person, firm or corporation identified as such in Agreement or Documents, and is licensed to practice in Place of the Work, and has been appointed by Owner to act for Owner in a professional capacity in relation to the Work.
- .14 Wherever words "indicated", "shown", "noted", "listed", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean product referred to is "indicated", "shown", "listed", or "noted" on Contract Documents.

- .15 Wherever words "reviewed", "satisfactory", "as directed", "submit", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "to the satisfaction of", "submitted to", etc., Consultant.

1.04 Documents

- .1 Documents for bidding include but are not limited to issued Drawings, Specifications and Addenda.
- .2 Specification is arranged in accordance with CSI/CSC 49 Divisions of MasterFormat.
- .3 Drawings and Specifications are portions of Contract Documents and identify labour, products and services necessary for performance of work and form a basis for determining pricing. They are intended to be cooperative. Perform work that is shown, specified, or reasonably implied on the drawings but not mentioned in Specification, or vice-versa, as though fully covered by both.
- .4 Review Drawings and Specifications in conjunction with documents of other Divisions and, where applicable, Code Consultant's report.
- .5 Unless otherwise specifically noted in Specifications and/or on Drawings, Sections of Mechanical Divisions 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 Sections are to be read as a whole.
- .6 Drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of building is to be taken on site. Do not scale Drawings, and do not use Drawings for prefabrication work.
- .7 Drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, offsets, fittings, transformations and similar products required as a result of obstructions and other architectural and/or structural details but not shown on Drawings.
- .8 Locations of equipment and materials shown may be altered, when reviewed by Consultant, to meet requirements of equipment and/or materials, other equipment or systems being installed, and of building, all at no additional cost to Contract.
- .9 Specification does not generally indicate specific number of items or amounts of material required. Specification is intended to provide product data and installation requirements. Refer to schedules, Drawings (layouts, riser diagrams, schematics, details) and Specification to provide correct quantities. Singular may be read as plural and vice versa.
- .10 Starter/motor control centre (MCC)/variable frequency drive (VFD) schedule drawings are both mechanical and electrical, and apply to work of Mechanical Divisions and Electrical Divisions. Be responsible for reviewing starter, MCC, VFD, and motor specification requirements prior to Bid submission. Confirm and coordinate exact scope of work and responsibility of work between Mechanical Divisions and Electrical Divisions.
- .11 Drawings and Specifications have been prepared solely for use by party with whom Consultant has entered into a contract and there are no representations of any kind made by Consultant to any other party.
- .12 In the case of discrepancies between the drawings and specifications, documents will govern in order specified in "General Conditions", however, when scale and date of drawings are same, or where discrepancy exists within specification, most costly arrangement will take precedence.

1.05 Metric and Imperial Measurements

- .1 Generally, both metric and imperial units of measurement are given in Sections of Specification governed by this section. Measurement conversions may be generally "soft" and rounded off. Confirm exact measurements based on application. Where measurements are related to installation and onsite applications, confirm issued document measurements with applicable local code requirements, and/or as applicable, make accurate measurements onsite. Where significant discrepancies are found, immediately notify Consultant for direction.

1.06 Examination of Documents and Site

- .1 Carefully examine Documents and visit site to determine and review existing site conditions that will or may affect work, and include for such conditions in Bid Price.
- .2 Report to Consultant, prior to Bid Submittal, any existing site condition that will or may affect performance of work as per Documents. Failure to do so will not be grounds for additional costs.
- .3 Upon finding discrepancies in, or omissions from Documents, or having doubt as to their meaning or intent, immediately notify Consultant, in writing.

1.07 Work Standards

- .1 Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of submission of Bids adopted by and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.
- .2 Where regulatory codes, standards and regulations are at variance with Drawings and Specification, more stringent requirement will apply unless otherwise directed by Owner and reviewed with Consultant.
- .3 Supplementary mandatory specification and requirements to be used in conjunction with project include but are not limited to following:
 - .1 Air-Conditioning, Heating and Refrigeration Institute (AHRI);
 - .2 Air Movement and Control Association (AMCA);
 - .3 American Iron and Steel Institute (AISI);
 - .4 American National Standards Institute (ANSI);
 - .5 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE);
 - .6 American Society of Mechanical Engineers (ASME);
 - .7 American Society of Testing and Materials (ASTM);
 - .8 American Water Works Association (AWWA);
 - .9 Associated Air Balance Council (AABC);
 - .10 Building Industry Consulting Services, International (BICSI);
 - .11 Canadian Gas Association (CGA);
 - .12 Canadian General Standards Board (CGSB);
 - .13 Canadian Standards Association (CSA);
 - .14 Electrical and Electronic Manufacturers Association of Canada (EEMAC);
 - .15 Electrical Safety Authority (ESA);
 - .16 Electronic Industries Association (EIA);
 - .17 Factory Mutual Systems (FM);
 - .18 Illuminating Engineering Society (IES);

- .19 Institute of Electrical and Electronic Engineers (IEEE);
 - .20 International Standards Organization (ISO);
 - .21 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS);
 - .22 National Building Code of Canada (NBC);
 - .23 National Electrical Manufacturers Association (NEMA);
 - .24 National Environmental Balancing Bureau (NEBB);
 - .25 National Fire Protection Association (NFPA);
 - .26 National Standards of Canada;
 - .27 NSF International;
 - .28 Occupational Health and Safety Act (OHSA);
 - .29 Ontario Building Code (OBC);
 - .30 Ontario Electrical Safety Code (OESC);
 - .31 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA);
 - .32 Technical Standards and Safety Authority (TSSA);
 - .33 Thermal Insulation Association of Canada (TIAC);
 - .34 Underwriters' Laboratories of Canada (ULC);
 - .35 Workplace Hazardous Materials Information System (WHMIS);
 - .36 Material Safety Data Sheets by product manufacturers;
 - .37 Local utility inspection permits;
 - .38 Codes, standards, and regulations of local governing authorities having jurisdiction;
 - .39 Additional codes and standards listed in Trade Sections;
 - .40 Owner's standards.
- 4 Provide applicable requirements for barrier free access in accordance with latest edition of local governing building code.
- 5 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 to appropriate authorities. Be responsible for costs associated with these submittals.
- 6 Unless otherwise specified, install equipment in accordance with equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.
- 7 Work is to be performed by journeyman tradesmen who perform only work that their certificates permit, or by apprentice tradesmen under direct on site supervision of experienced journeyman tradesman. Journeyman to apprentice ratio is not to exceed ratio determined by the Board as stated in Ontario College of Trades and Apprenticeship Act or local equivalent governing body in Place of the Work.

- .8 Journeyperson tradesmen are to have a copy of valid trade certificates available at site for review with Consultant at any time.
- .9 Experienced and qualified superintendent is to be on-site at times when work is being performed.
- .10 Coordinate work inspection reviews and approvals with governing inspection department to ensure that construction schedule is not delayed. Be responsible for prompt notification of deficiencies to Consultant and submission of reports and certificates to Consultant.
- .11 Properly protect equipment and materials on site from damage due to elements and work of trades, to satisfaction of Owner and reviewed with Consultant. Equipment and materials are to be in new condition upon Substantial Performance of the Work.
- .12 Mechanical piping system work, including equipment, must comply in all respects with requirements of local technical standards authorities and CSA B51, Boiler, Pressure Vessels and Pressure Piping Code. Where required, mechanical work products must bear a CRN number.
- .13 Electrical items associated with mechanical equipment are to be certified and bear 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.

1.08 Permits, Certificates, Approvals, and Fees

- .1 Contact and confirm with local authorities having jurisdiction including utility providers, requirements for approvals from such authorities. Obtain and pay for permits, certificates, and approvals required to complete Work.
- .2 Be responsible for ensuring that authorities having jurisdiction which require on-site inspection of work, have ample notification to perform inspection, with sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of Work. If any defect, deficiency or non-compliant is found in work by inspection, be responsible for costs of such inspection, including any related expenses, making good and return to site, until work is passed by governing authorities.
- .3 Obtain and submit to Consultant, approval/inspection certificates issued by governing authorities to confirm that Work as installed is in accordance with rules and regulations of local governing authorities and are acceptable.
- .4 Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities.

1.09 Requirements for Contractor Retained Engineers

- .1 Professional engineers retained to perform consulting services with regard to Project work, i.e. seismic engineer, fire protection engineer or structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in Place of the Work.
- .2 Retained engineer's professional liability insurance is to protect Contractor's consultants and their respective servants, agents, and employees against any loss or damage resulting from professional services rendered by aforementioned consultants and their respective servants, agents, and employees in regards to the Work of this Contract.
- .3 Unless otherwise specified in Division 00 or 01, liability insurance requirements are as follows:
 - .1 coverage is to be a minimum of \$1,000,000.00 CDN inclusive of any one occurrence;
 - .2 insurance policy is not to be cancelled or changed in any way without insurer giving Owner minimum thirty days written notice;
 - .3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the Place of the Work;
 - .4 retained consultants are to ascertain that sub-consultants employed by them carry insurance in the form and limits specified above;

- .5 evidence of the required liability insurance in such form as may be required is to be issued to Owner, Owner's Consultant, and Municipal Authorities as required prior to commencement of aforementioned consultant's services.

1.10 Workplace Safety

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for products where required, and maintain one copy at site in a visible and accessible location available to personnel.
- .2 Comply with requirements of Occupational Health and Safety Act and other regulations pertaining to health and safety, including worker's compensation/insurance board and fall protection regulations. When working in confined spaces, comply with requirements of Occupational Health and Safety Act - Ontario Regulation 632, "Confined Spaces" and any other applicable Ministry of Labour requirements.
- .3 If at any time during course of work, hazardous materials other than those identified in Documents and pertaining to Project Scope of Work, are encountered or suspected that were not identified as being present and which specific instructions in handling of such materials were not given, cease work in area in question and immediately notify Consultant. Comply with local governing regulations with regards to working in areas suspected of containing hazardous materials. Do not resume work in affected area without approval from Owner and reviewed with Consultant.

1.11 Planning and Layout of Work

- .1 Base installation layout, design, terminations, and supply of accessories, on Contract Documents with specific coordination with reviewed shop drawings.
- .2 Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other as well as other obstructions. Generally, order of right of way for services to be as follows:
 - .1 piping requiring uniform pitch;
 - .2 piping 100 mm (4") dia. and larger;
 - .3 large ducts (main runs);
 - .4 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..
- .3 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify Consultant where headroom or ceiling space appears to be inadequate prior to installation of work.
- .4 Do not use Contract Drawing measurements for prefabrication and layout of piping, sheet metal work and such other work. Locations and routing are to generally be in accordance with Contract Drawings, however, prepare layout drawings for such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for work of other trades. Accurately layout work, and be entirely responsible for work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with Contract Drawings, notify Consultant prior to proceeding with work.
- .5 Prepare plan and interference drawings (at a minimum drawing scale of 1:50 or 1/4"=1' 0") of work for coordination with each trade Contractor. Arrange for preparation of detailed section drawings of ceiling spaces of corridors and any other congested areas. Sections are to be cross referenced with plan drawings so that trades may make use of section drawings. Section

drawings to indicate lateral and elevation dimensions of major services within ceiling space. Lateral dimensions are to be from grid lines and elevations from top of floor slab. Obtain from Consultant, engineering drawings for this use. Contractors' interference drawings are to be distributed among other Trade Contractors. Submit drawings to Consultant for review. Failure of General Contractor to prepare and coordinate overall interface drawings of trades does not relieve respective Division Contractor of responsibility to ensure that work is properly planned and coordinated.

- .6 Carry out alterations in arrangement of work that has been installed without proper coordination, study, and review, even if in accordance with Contract Documents, in order to conceal work behind finishes, or to allow installation of other work, without additional cost. In addition, make necessary alterations in other work required by such alterations, without additional cost.
- .7 Shut-off valves, balancing devices, air vents, 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.
- .8 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were missed due to lack of coordination.

1.12 Phasing

- .1 Include for any and all scheduling, coordination, and construction phasing to suit project, specified in Division 01 and/or as indicated on the drawings. Review exact phasing requirements with Consultant prior to start of Work.
- .2 Phasing and scheduling of Work is required in order to maintain existing building operations. Include costs (including costs for "off hours" work) for scheduling, co-ordination, and construction phasing to suit this project as specified in Division 01 and on drawings. Review phasing requirements with Consultant prior to start of Work.
- .3 Protect existing areas above, below and adjacent areas of Work from any debris, noise, or interruptions to existing services to satisfaction of Owner and reviewed with Consultant. Maintain in operation existing services to these areas to allow Owner to continue use of these areas. If services that are required to be maintained run through areas of renovations, provide necessary protection to services or reroute, in coordination with Owner and Consultant. Include for required premium time work to meet these requirements.
- .4 Work being performed within occupied spaces and work affecting surfaces adjacent to occupied spaces may need to be performed after regular business hours. For areas where spaces are used by Owner on a 24 hours basis or over various hours, coordinate hours of work with Owner on a regular basis to suit Owner's schedule. Execute work at times confirmed with and agreed to by Owner and reviewed with Consultant, so as not to inconvenience Owner's occupation or in any way hinder Owner's use of building. Include for required premium timework to meet these requirements.
- .5 Project partial occupancy permits may be required throughout project. Provide for each partial permit, required local governing authority certificate and any other testing/verification certificates for systems.

1.13 Coordination of Work

- .1 Review Contract Documents and coordinate work with work of each trade. Coordination requirements are to include but not be limited to following:
 - .1 requirements for openings, sleeves, inserts and other hardware necessary for installation of work;
 - .2 concrete work such as housekeeping pads, sumps, bases, etc., required for work, and including required dimensions, operating weight of equipment, location, etc.;
 - .3 depth and routing of excavation required for work, and requirements for bedding and backfill;
 - .4 wiring work required for equipment and systems but not specified to be done as part of mechanical work, including termination points, wiring type and size, and any other requirements.
- .2 Ensure materials and equipment are delivered to site at proper time and in such assemblies and sizes so as to enter into building and be moved into spaces where they are to be located without difficulty.

- .3 Wherever possible, coordinate equipment deliveries with manufacturers and/or suppliers so equipment is delivered to site when it is required, or so it can be stored within building, subject to available space as confirmed with Owner and reviewed with Owner, and protected from elements.
- .4 Ensure proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Comply with code requirements with regards to access space provision around equipment. Remove and replace any equipment which does not meet this requirement.
- .5 Where work is to be integrated, or is to be installed in close proximity with work of other trades, coordinate work prior to and during installation.

1.14 Products

- .1 Be responsible for ordering of products (equipment and materials) in a timely manner in order to meet project-scheduling timelines. Failure to order products to allow manufacturers sufficient production/delivery time to meet project-scheduling timelines is an unacceptable reason to request for other suppliers or substitutions.
- .2 Provide Canadian manufactured products wherever possible or required and when quality and performance is obtainable at a competitive price. Products are to be supplied from manufacturer's authorized Canadian representative, unless otherwise noted. Unless otherwise specified, products are to be new and are to comply with applicable respective Canadian standards. References to UL listings of products to include requirements that products are to be also Underwriters Laboratories of Canada (ULC) listed for use in Canada. Products are to meet or exceed latest ANSI/ASHRAE/IES 90.1 standards, as applicable. Do not supply any products containing asbestos materials or PCB materials.
- .3 Systems and equipment of this Project are to be "State of the Art" and be most recent and up to date series/version of product that is available at time of shop drawing review process. Products that have been stored or "on shelf" for an extended period of time will not be accepted. Software is to be of latest version available and be provided with updates available at time of shop drawing review process. Systems are to be designed such that its software is backwards compatible. Future upgrades are not to require any hardware replacements or additions to utilize latest software.
- .4 Products scheduled and/or specified have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In most cases, base specified manufacturers are stated for any product specified by manufacturer's name and model number. Where acceptable manufacturers are listed, first name listed is base specified company. Bid Price may be based on products supplied by any of manufacturers' base specified or named as acceptable for particular product. If acceptable manufacturers are not stated for a particular product, base Bid Price on product supplied by base specified manufacturer.
- .5 Documents have been prepared based on product available at time of Bidding. If, after award of Contract, and if successful manufacturer can no longer supply a product that meets base specifications, notify Consultant immediately. Be responsible for obtaining other manufacturers product that complies with base specified performance and criteria and meets project timelines. Proposed products are subject to review and consideration by Consultant and are considered as substitutions subject to a credit to Contract. In addition, if such products require modifications to room spaces, mechanical systems, electrical systems, etc., include required changes. Such changes are to be submitted in detail to Consultant for review and consideration for acceptance. There will be no increase in Contract Price for revisions. Above conditions supplement and are not to supersede any specification conditions with regards to substitutions or failure to supply product as per issued documents.
- .6 Listing of a product as "acceptable" does not imply automatic acceptance by Consultant and/or Owner. It is responsibility of Contractor to ensure that any price quotations received and submittals made are for products that meet or exceed specifications included herein.
- .7 If products supplied by a manufacturer named as acceptable are used in lieu of base specified manufacturer, be responsible for ensuring that they are equivalent in performance and operating characteristics (including energy consumption if applicable) to base specified products. It is understood that any additional costs (i.e. for larger starters, larger feeders, additional spaces, etc.), and changes to associated or adjacent work resulting from provision of product supplied by a manufacturer other than base specified manufacturer, is included in Bid Price. In addition, in equipment spaces where equipment named as acceptable is used in lieu of base specified equipment and dimensions of such equipment differs from base specified equipment, prepare and submit for review accurately dimensioned layouts of rooms affected, identifying architectural and structural elements, systems

and equipment to prove that equipment in room will fit properly meeting design intent. There will be no increase in Contract Price for revisions.

- .8 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are accepted in writing by Consultant.
- .9 Where products are listed as "or approved equal", certify in writing that product to be used in lieu of base specified product, at least meets space, power, design, energy consumption, and other requirements of base specified product and is equivalent or better than base specified product. When requested by Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equal" products is at sole discretion of Consultant. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of approved equal product. There must be no increase in Contract price due to Consultant's rejection of proposed equivalent product.
- .10 Whenever use of product other than base specified product is being supplied, ensure corresponding certifications and product information (detailed catalogue and engineering data, fabrication information and performance characteristics) are submitted to Consultant for review. Failure of submission of these documents to Consultant in a timely manner to allow for review will result in base specified product to be supplied at Consultant's discretion, at no additional cost to Contract.
- .11 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable may be considered for acceptance by Consultant if requested in writing with full product documentation submitted, a minimum of 10 working days prior to Bid closing date.
- .12 Any proposed changes initiated by Contractor after award of Contract may be considered by Consultant at Consultant's discretion, with any additional costs for such changes if accepted by Owner and reviewed with Consultant, and costs for review, to be borne by Contractor.
- .13 Whenever use of product other than based specified products or named as acceptable is being supplied, time for process of submission of other products and Consultant's review of products will not alter contract time or delay work schedule.

1.15 Shop Drawings

- .1 At start-up meeting, review with Consultant products to be included in shop drawing submission. Prepare and submit list of products to Consultant for review.
- .2 Submit electronic copies of shop drawings unless otherwise directed by Consultant. Coordinate exact requirements with Consultant.
- .3 Submit for review, drawings showing detail design, construction, and performance of equipment and materials as requested in Specification. Submit shop drawings to Consultant for review prior to ordering and delivery of product to site. Include minimally for preparation and submission of following, as applicable:
 - .1 product literature cuts;
 - .2 equipment data sheets;
 - .3 equipment dimension drawings;
 - .4 system block diagrams;
 - .5 sequence of operation;

- .6 connection wiring schematic diagrams;
- .7 functionality with integrated systems.
- .4 Each shop drawing or product data sheet is to be properly identified with project name and product drawing or specification reference. Shop drawing or product data sheet dimensions are to match dimension type on drawings.
- .5 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 this requirement is clearly indicated on submission.
- .6 Ensure proposed products meet each requirement of Project. Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS". Include company name, submittal date, and sign each copy. Shop drawings that are received and are not endorsed, dated and signed will be returned to be resubmitted.
- .7 Consultant to review shop drawings and indicate review status by stamping shop drawing copies as follows:
 - .1 "REVIEWED" or "REVIEWED AS NOTED" (appropriately marked) – If Consultant's review of shop drawing is final, Consultant to stamp shop drawing;
 - .2 "RETURNED FOR CORRECTION" – If Consultant's review of shop drawing is not final, Consultant to stamp shop drawing as stated above, mark submission with comments, and return submission. Revise shop drawing in accordance with Consultant's notations and resubmit.
- .8 Following is to be read in conjunction with wording on Consultant's shop drawing review stamp applied to each and every shop drawing or product data sheet submitted:
 - .1 "THIS REVIEW BY CONSULTANT IS FOR SOLE PURPOSE OF ASCERTAINING CONFORMANCE WITH GENERAL DESIGN CONCEPT. THIS REVIEW DOES NOT MEAN THAT CONSULTANT APPROVES DETAILED DESIGN INHERENT IN SHOP DRAWINGS, RESPONSIBILITY FOR WHICH REMAINS WITH CONTRACTOR. CONSULTANT'S REVIEW DOES NOT RELIEVE CONTRACTOR OF RESPONSIBILITY FOR ERRORS OR OMISSIONS IN SHOP DRAWINGS OR OF CONTRACTOR'S RESPONSIBILITY FOR MEETING REQUIREMENTS OF CONTRACT DOCUMENTS. BE 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 COORDINATION OF WORK OF SUB-TRADES."
- .9 Submit each system and each major component as separate shop drawing submissions. Submit together, shop drawings for common devices such as devices of each system are to be submitted together.
- .10 Obtain shop drawings for submission from product manufacturer's authorized representatives and supplemented with additional items specified herein.
- .11 Do not order product until respective shop drawing review process has been properly reviewed with Consultant.
- .12 Where extended warranties are specified for equipment items, submit specified extended warranty with shop drawing submittal.
- .13 Applicable mechanical equipment has been selected to meet energy efficiency requirements of ANSI/ASHRAE/IES 90.1, Energy Standards for Buildings, and shop drawings/product data submittals for such equipment must indicate compliance with this Standard or they will be returned for correction and re-submittal.

1.16 Equipment Loads

- .1 Supply equipment loads (self-weight, operating weight, housekeeping pad, inertia pads, etc.) to Consultant, via shop drawing submissions, prior to construction.
- .2 Where given choice of specific equipment, actual weight, location and method of support of equipment may differ from those assumed by Consultant for base design. Back-check equipment loads, location, and supports, and include necessary accommodations.

- .3 Where supporting structure consists of structural steel framing, it is imperative that equipment loads, location, and method of support be confirmed prior to fabrication of structural steel. Review locations of equipment with Consultant prior to construction.

1.17 Openings

- .1 Supply opening sizes and locations to Consultant to allow verification of their effect on design, and for inclusion on structural drawings where appropriate.
- .2 No openings are permitted through completed structure without written approval from Owner and reviewed with Consultant. Show required openings on a copy of structural drawings. Identify exact locations, elevations, and size of proposed openings and submit to Consultant for review, well in advance of doing work.
- .3 Prior to leaving site at end of each day, walk through areas of work and check for any openings, penetrations, holes, and/or voids created under scope of work of project, and ensure that any openings created under scope of work have been closed off, fire-stopped and smoke-sealed. Unless directed by Owner and reviewed with Consultant, do not leave any openings unprotected and unfinished overnight.

1.18 Scaffolding, Hoisting and Rigging

- .1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval from Owner and reviewed with Consultant.
- .2 Immediately remove from site scaffolding, rigging and hoisting equipment when no longer required.
- .3 Do not place major scaffolding/hoisting equipment loads on any portion of structure without approval from Owner and reviewed with Consultant.

1.19 Changes in the Work

- .1 Whenever Consultant proposes in writing to make a change or revision to design, arrangement, quantity or type of work from that required by Contract Documents, prepare and submit to Consultant for review, a quotation being proposed cost for executing change or revision.
- .2 Quotation is to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.
- .3 Unless otherwise specified in Division 00 or 01, allowable maximum percentages for overhead and profit are to be 7% and 5% respectively.
- .4 Unless otherwise specified in Divisions 00 or 01, following additional requirements apply to all quotations submitted:
 - .1 when change or revision involves deleted work as well as additional work, cost of deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from cost of additional work before overhead and profit percentages are applied to additional work;
 - .2 material costs are not to exceed those published in local estimating price guides;
 - .3 mechanical material labour unit costs are to be in accordance with Mechanical Contractors Association of America Labor Estimating Manual, less 25%;
 - .4 electrical material labour unit costs are to be in accordance with National Electrical Contractors Association Manual of Labor Units at difficult level, less 25%;
 - .5 costs for journeyman and apprentice labour must not exceed prevailing rates at time of execution of Contract and must reflect actual personnel performing work;
 - .6 cost for site superintendent must not exceed 10% of total hours of labour estimated for change or revision, and change or revision must be such that site superintendent's involvement is necessary;

- .7 costs for rental tools and/or equipment are not to exceed local rental costs;
 - .8 overhead percentage will be deemed to cover quotation costs other than actual site labour and materials, and rentals;
 - .9 quotations, including those for deleted work, to include a figure for any required change to Contract time.
- .5 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 Consultant to expeditiously process quotation and issue a Change Order will not be grounds for any additional change to Contract time.
 - .6 Make requests for changes or revisions to work to Consultant in writing and, if Consultant agrees, will issue Notice of Change.
 - .7 Do not execute any change or revision until written authorization for the change or revision has been obtained from Consultant.

1.20 Progress Payment Breakdown

- .1 Prior to submittal of first progress payment draw, submit a detailed breakdown of work cost to assist Consultant in reviewing and approving progress payment claims.
- .2 Payment breakdown is subject to Owner's approval and Consultant's review. Progress payments will not be processed until an approved breakdown is in place. Breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, system testing and verification, and project closeout submittals.
- .3 Indicate equipment, material and labour costs for site services (if applicable) and indicate work of each trade in same manner as indicated on progress draw.

1.21 Notice for Required Field Reviews

- .1 Whenever there is a requirement for Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect work for deficiencies prior to Substantial Performance of the Work, for commissioning demonstrations, and any other such field review, give minimum 5 working days' notice in writing to Consultant.
- .2 If Consultant is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until Consultant advises that it may be concealed.
- .4 When Consultant is requested to perform a field review and work is not ready to be reviewed, reimburse Consultant for time and travel expenses.

1.22 Preliminary Testing

- .1 When directed by 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 Specification and governing Codes and Regulations, prior to Substantial Performance of the Work.
- .2 When, in Consultant's opinion, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.
- .3 These tests are not to be construed as evidence of acceptance of work, and it is agreed and understood that no claim for delays or damage will be made for injury or breakage to any part or parts of equipment or system due to test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.
- .4 When, in Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from site and replace them with acceptable equipment and/or products, at no additional cost.

1.23 Provisions for Systems/Equipment Used During Construction

- .1 Permanent building mechanical systems are not to be used for temporary heating or cooling purposes during construction.

1.24 Temporary Services

- .1 Coordinate with Prime Contractor, requirements for temporary services including but not limited to temporary heating, cooling and water. Unless otherwise noted, provide required services in compliance with requirements of local governing building code and local governing inspection authorities.
- .2 Maintain fire protection of areas which may include fire watch during temporary shutdowns of existing systems, in accordance with requirements of local governing code and local governing authorities.

1.25 Maintaining Equipment Prior to Acceptance

- .1 Maintain equipment in accordance with the manufacturer's printed instructions prior to start-up, testing and commissioning.
- .2 Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.
- .3 Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminium tubing.
- .4 All filters are to be new upon Substantial Performance of the Work. This is in addition to any spare filters specified.

1.26 Cleaning

- .1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Owner and Consultant. Before applying for a Certificate of Substantial Performance of the Work, remove rubbish and debris, and be responsible for repair of any damage caused as a result of work.
- .2 Clean equipment and devices installed as part of this project.

1.27 Record As-Built Drawings

- .1 Drawings for this project have been prepared on a CAD system using AutoCAD software of release version reviewed with Consultant. For purpose of producing record "as built" drawings, copies of Contract Drawings can be obtained from Consultant.
- .2 As work progresses at site, clearly mark in red in a neat and legible manner on a set of bound white prints of Contract Drawings, changes and deviations from routing of services and locations of equipment shown on Contract Drawings, on a daily basis. Changes and deviations include those made by addenda, change orders, and site instructions. Use notes marked in red as required. Maintain white print red line as-built set at site for exclusive use of recording as-built conditions, keep set up-to-date at all times, and ensure set is always available for periodic review. As-built set is also to include the following:
 - .1 dimensioned location of inaccessible concealed work;
 - .2 locations of control devices with identification for each;
 - .3 for underground piping and ducts, record dimensions, invert elevations, offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks to be preserved after construction is complete;
 - .4 for fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings;
 - .5 location of piping system air vents;
 - .6 location of concealed services terminated for future extension and work concealed within building in inaccessible locations.
- .3 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of Consultant.

- .4 Use final reviewed "as-built" drawing set to provide CAD files of drawings thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by Consultant as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Consultant.
- .5 Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with AutoCAD software release version confirmed with Consultant.
- .6 Unless otherwise noted in Divisions 00 or 01, failure to maintain accurate record drawings will incur additional 5% holdback on progress claims until drawings are brought up to date to satisfaction of Owner and reviewed with Consultant.
- .7 For projects with phased turnover of project (refer to Division 01), review with Consultant completeness of as-built drawings prior to turn over of an area. Interim as-built drawings to be made available to Owner's maintenance personnel.
- .8 Where part of the Mechanical Scope of Work, retain and pay for services of a land surveyor registered in Place of the Work to measure, verify, and record size, location, invert elevation and pitch of buried piping services, and, when complete, transfer survey work to as-built drawings.

1.28 Operating and Maintenance Manuals

- .1 For each item of equipment for which a shop drawing is required (except for simple equipment), supply indexed copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Consolidate each copy of data as a PDF file on a USB drive. Consolidated O&M manual PDF to include:
 - .1 front cover: project name; wording – "Mechanical Systems Operating and Maintenance Manual"; and date;
 - .2 introduction sheet listing Consultant, Contractor, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses;
 - .3 equipment manufacturer's authorized contact person name, telephone number and company website;
 - .4 Table of Contents sheet, and corresponding index tab sheets;
 - .5 copy of each "REVIEWED" or clean, updated "REVIEWED AS NOTED" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, company website address, and email address for local source of parts and service; when shop drawings are returned marked "Reviewed As Noted" with revisions marked on shop drawing copies, they are to be revised by equipment supplier to incorporate comments marked on "Reviewed" shop drawings and a clean updated copy is to be included in operating and maintenance manuals;
 - .6 Operating data is to include:
 - .1 pressure test reports, and certificates issued by governing authorities;
 - .2 description of each system and its controls;
 - .3 control schematics for equipment/systems including building environmental controls;
 - .4 wiring and connection diagrams;
 - .5 if applicable, BAS architecture and all required operating data;
 - .6 description of operation of each system at various loads together with reset schedules and seasonal variances;
 - .7 operation instruction for each system and each component;
 - .8 description of actions to be taken in event of emergencies and/or equipment failure;

- .9 valve tag schedule, and flow diagrams to indicate valve locations.
- .7 Maintenance data is to include:
 - .1 operation and trouble-shooting instructions for each item of equipment and each system;
 - .2 schedules of tasks, frequency, tools required, and estimated task time;
 - .3 recommended maintenance practices and precautions;
 - .4 complete parts lists with numbers.
- .8 Performance data is to include:
 - .1 equipment and system start-up data sheets;
 - .2 equipment performance verification test results, and final commissioning report;
 - .3 final testing, adjusting and balancing reports.
- .9 copies of warranties;
- .10 items requested specifically in Section Articles.
- .2 Operating and maintenance instructions are to relate to job specific equipment supplied under this project and related to Owner's building. Language used in manuals is to contain simple practical operating terms and language easy for in-house maintenance staff to understand how to operate and maintain each system.
- .3 Before applying for a Certificate of Substantial Performance of the Work, assemble one copy of O & M Manual and submit to Consultant for review prior to assembling remaining copies. Incorporate Consultant's comments into final submission.

1.29 Commissioning

- .1 After successful start-up and prior to Substantial Performance of the Work, commission the mechanical work. Commissioning work is the process of Contractor demonstrating to Owner and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents, as further described below.
 - .1 Retain services of a testing, adjusting, and balancing agency to perform testing and balancing of mechanical system air/fluid flows and capacities, prior to operational performance testing. Refer to Section 20 05 93 – Testing, Adjusting, and Balancing for Mechanical Systems.
 - .2 Test, adjust and operate equipment and systems after start-up but before functional performance testing, to confirm operations are in accordance with requirements of Contract Documents. Verify modes and sequences of control and monitoring, interlocks, and responses to emergency conditions. Complete commissioning data sheets to document successful operational performance testing.
 - .3 Repeat successful operational performance testing with completed commissioning data sheet documentation in the presence of Consultant and Owner to validate and verify equipment and systems are complete in all respects, function correctly, and are ready for acceptance.
 - .4 Submit final commissioning data sheets, TAB reports as specified in Section 20 05 93 – Testing, Adjusting, and Balancing for Mechanical Systems, project closeout documents, and other required submittals.

1.30 Warranty

- .1 Unless otherwise specified in Divisions 00 and 01, warrant mechanical work to be in accordance with Contract Documents and free from defects for a period of two (2) years from date of issue of a Certificate of Substantial Performance of the Work.

- .2 Where equipment includes extended warranty period, e.g., 5 years, first year of warranty period is to be governed by terms and conditions of warranty in Contract Documents, and remaining years of warranty are to be direct from equipment manufacturer and/or supplier to Owner. Submit signed and dated copies of extended warranties to Consultant.
- .3 Warranty to include parts, labour, travel costs and living expenses incurred by manufacturer's authorized technician to provide factory authorized on-site service.
- .4 Repair and/or replace any defects that appear in Work within warranty period without additional expense to Owner. Be responsible for costs incurred in making defective work good, including repair or replacement of building finishes, other materials, and damage to other equipment. Ordinary wear and tear and damage caused wilfully or due to carelessness of Owner's staff or agents is exempted.
- .5 Do not include Owner deductible amounts in warranties.
- .6 It is understood that warranties are to commence from time of Substantial Performance of the Work, regardless of what is noted within following Sections of Specification. Be responsible for providing whatever "bridging" or additional extended warranty period is required from time that material is purchased until this time.
- .7 Visit building during warranty period with Owner representatives. Owner to organize these visits. At these meetings, Owner representatives are to review performance of systems. If performance is satisfactory, then no further action needs to be taken. If unsatisfactory, then correct deficiencies, as directed by Owner representatives, to satisfaction of Owner's representatives. These site visits to occur:
 - .1 once during 1st month of building operation;
 - .2 once during 3rd month of building operation;
 - .3 once between 4th and 10th month in a season opposite to 1st and 3rd month visits.

1.31 Closeout Submittals

- .1 Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following as applicable to the project:
 - .1 Operating and Maintenance Manuals;
 - .2 as-built record drawings and associated data;
 - .3 extended warranties for equipment as specified;
 - .4 operating test certificates, i.e. Sprinkler Test Certificate;
 - .5 final commissioning report and TAB report;
 - .6 identified keys for equipment and/or panels for which keys are required, and other items required to be submitted;
 - .7 other data or products specified.

1.32 Instructions to Owner

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
- .2 Train Owner's designated personnel in aspects of operation and maintenance of equipment and systems as specified. Demonstrations and training are to be performed by qualified technicians employed by equipment/system manufacturer/supplier. Supply hard copies of training materials to each attendee.
- .3 Unless where specified otherwise in trade Sections, minimum requirements are for manufacturer/suppliers of each system and major equipment, to provide minimum two separate sessions each consisting of minimum 4 hours on site or in factory training (at

- Owner's choice), of Owner's designated personnel (for up to 6 people each session), on operation and maintenance procedures of system.
- 4 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Use Operating and Maintenance Manuals during training sessions. Training modules include but are not limited to:
 - .1 Operational Requirements and Criteria – equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations;
 - .2 Troubleshooting – diagnostic instructions, test and inspection procedures;
 - .3 Documentation – equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like;
 - .4 Maintenance – inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools;
 - .5 Repairs – diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.
 - 5 Before instructing Owner's designated personnel, submit to Consultant for review preliminary copy of training manual and proposed schedule of demonstration and training dates and times. Incorporate Consultant's comments in final copy.
 - 6 Obtain in writing from Consultant list of Owner's representatives to receive instructions. Submit to Consultant prior to application for Certificate of Substantial Performance of the Work, complete list of systems for which instructions were given, stating for each system:
 - .1 date instructions were given to Owner's staff;
 - .2 duration of instruction;
 - .3 names of persons instructed;
 - .4 other parties present (manufacturer's representative, consultants, etc.).
 - 7 Obtain signatures of Owner's staff to verify they properly understood system installation, operation and maintenance requirements, and have received operating and maintenance instruction manuals and "as-built" record drawings.
 - 8 Submit to Consultant copy of electronic version of training materials and include in operating and maintenance manuals submission.

1.33 Final Inspection

- .1 Submit to Consultant, written request for final inspection of systems. Include written certification that:
 - .1 deficiencies noted during job inspections have been completed;
 - .2 field quality control procedures have been completed;
 - .3 systems have been tested and verified, balanced and adjusted, and are ready for operation;
 - .4 maintenance and operating data have been completed and submitted to, reviewed with Consultant and accepted by Owner;
 - .5 tags and nameplates are in place and equipment identifications have been completed;
 - .6 clean-up is complete;
 - .7 spare parts and replacement parts specified have been provided and acknowledged by Consultant;

- .8 as-built and record drawings have been completed and submitted to and reviewed with Consultant and accepted by Owner;
- .9 Owner's staff has been instructed in operation and maintenance of systems;
- .10 commissioning procedures have been completed.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Submittals

- .1 Shop Drawings/Product Data: Submit shop drawings with product data sheets for variable frequency drives (VFDs). Include:
 - .1 construction and performance details;
 - .2 wiring and control schematics;
 - .3 dimensions of units;
 - .4 calculations specific to installation showing total harmonic voltage distortion is less than 5%;
 - .5 certified production test results with serial numbers for harmonic mitigation performance and energy efficiency under actual variable frequency drive loading.
- .2 Certification Letter: Submit a start-up and installation certification letter from supplier of VFDs as specified in Part 3 of this Section;
- .3 Parameters: Prepare list of parameters for uploading for Owner's future use as specified in Part 3 of this Section. Load on USB type flash drive and submit to Consultant.
- .4 Extended Warranty: Where extended warranty is specified to be included, include a copy of VFD extended warranty in each Operating and Maintenance Manual. Prior to Substantial Performance of Work, submit a copy of warranty to Owner.
- .5 Additionally, coordinate with Prime Contractor and Electrical Contractor to ensure that shop drawings clearly identify that proposed VFDs and connected motors are 100% compatible and Mechanical Contractor to sign off on selected VFDs.

1.02 Coordination with Electrical Divisions

- .1 This Section specifies VFD requirements for motors. Ensure that VFDs packaged with various system equipment, complies with specifications of this Section.
- .2 VFDs are each to be approved by respective manufacturers of VFDs and connected motors, as suitable for installation on scheduled motors. VFD output current rating to match or exceed connected motor nameplate full load current rating.
- .3 Coordinate and review with Electrical Divisions, responsibility requirements for supply of VFDs, harmonic filters and requirements for control and power conductors and connections.
- .4 Check that motors are equipped with AEGIS or approved equal, shaft grounding ring system to protect bearings from damage in motors by diverting harmful shaft voltages and bearing currents to ground.
- .5 Additionally, review and confirm responsibilities with Consultant and Prime Contractor.

2 Products

2.01 VFD Basic Requirements

- .1 VFDs supplied on project to be products of same manufacturer and be CSA approved, ULC listed and labelled. Base specified product is ABB ACH series units that include compliance with following standards:
 - .1 CSA C22.2 No.14 Industrial Control Equipment;
 - .2 UL 508 - Industrial Control Equipment;
 - .3 UL 508C – Power Conversion Equipment;

- .4 NEMA ICS 7 - Adjustable-Speed Drives.
- .2 Basis for limiting harmonics is to be provided generally to IEEE Standard 519 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems, except intended for user's electrical distribution system with point of common coupling (where harmonic limits are assessed) to be set at input terminals of harmonic mitigating equipment.
- .3 Refer to Schedule of VFDs on drawings for features to include with respective VFDs.
- .4 VFDs to include following basic requirements:
 - .1 regardless of HP rating are to be of same VFD model; I/O and control circuit boards as well as keypads are to be identical and interchangeable regardless of HP rating;
 - .2 to be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without safety tripping or component damage (flying start);
 - .3 6-pulse width modulated (PWM) AC to AC converter utilizing latest isolated gate bipolar transistor (IGBT) technology; PWM switching pattern to include a motor flux optimization circuit that automatically reduces applied motor voltage to the motor to optimize energy consumption and audible motor noise;
 - .4 carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency without derating VFD or operating at high carrier frequency only at low speeds;
 - .5 provisions that determines motor torque and flux every 25 microseconds (40,000 times per second);
 - .6 completely assembled and tested by manufacturer in their facility;
 - .7 designed to provide at least 250,000 hours mean time before failure (MTBF) when specified preventative maintenance is performed.
 - .8 bypass system completely factory wired and tested;
 - .9 door interlocked padlockable disconnect switch that disconnects all input power from drive and all internally mounted options;
 - .10 control panel keyboard and display with password protection against parameter changes.

2.02 VFD Ratings

- .1 VFDs to be rated to operate from 3 phase input voltage of 208 or 600 volts \pm 10%, as scheduled, and frequency range from 48 to 63 Hz. In addition, a tolerated voltage window to allow system to operate from a line of +30% to -35% nominal voltage. System to incorporate circuitry that allows drive or bypass contactor to remain "sealed in" over this voltage tolerance at a minimum.
- .2 VFDs to employ a full wave rectifier to prevent input line notching and operate at a minimum fundamental input power factor of 0.97 at all speeds and loads.
- .3 VFDs efficiency to be 96% or better at full speed and load.
- .4 Output voltage and current ratings to match adjustable frequency operating requirements of standard 3ph, 60Hz, NEMA design B inverter-duty motors in compliance with NEMA-MG1, Part 31 Standard. Overload current capacity for variable torque overload capacity to be 110% of rated current for 1 minute out of 10 minutes and 130% for 2 seconds. Output frequency to be adjustable between 0 and 500 Hz.
- .5 Open loop static speed regulation to be 0.1% to 0.3% (10% of motor slip). Dynamic speed accuracy to be 4%-sec. or better open loop.
- .6 When a suitable motor is used, drive provides breakaway torque equal to 200% of rated motor torque. Torque response time to be 5 ms or less.

- .7 Enclosures:
 - .1 in climate controlled areas – minimum NEMA 12 with drip shield;
 - .2 in non-climate controlled areas – NEMA 3R.

2.03 Harmonic Filters and Reactors

- .1 VFDs to include internal 5% impedance AC line reactor (or equivalent 5% impedance dual positive and negative DC bus reactors) provided as a standard to reduce input current harmonic content and provide isolation from power line transients and to reduce RFI emissions.
- .2 VFDs to be provided with harmonic filters to limit harmonics distortion produced by each drive to following maximum levels as measured on input side of drive:
 - .1 Total harmonic distortion (voltage) – 5%;
 - .2 Total harmonic distortion (current) – 10%.
- .3 Harmonic filter to be based on MIRUS International Inc. “LINEATOR AUHF” series, with features as follows:
 - .1 manufactured and tested in accordance with latest applicable standards of ULC, CSA and NEMA;
 - .2 treat characteristic low frequency harmonics generated by a 3-phase, diode bridge rectifier load (5th, 7th, 11th, 13th, etc.);
 - .3 passive inductor/capacitor network;
 - .4 low capacitive reactance (KVAR) of less than 20% of kVA rating, to ensure compatibility with engine generator sets;
 - .5 full load efficiency of harmonic mitigation equipment / VFD combination to be greater than 96%;
 - .6 copper wiring;
 - .7 220°C system insulation class and temperature rise of 130°C;
 - .8 anti-vibration pads between reactor or transformer core and enclosure;
 - .9 manufacturer’s standard ventilated, NEMA-3R enclosure.

2.04 Controls and Adjustment Functions

- .1 Include for following:
 - .1 programmable critical frequency lockout ranges to prevent VFD from operating load continuously at an unstable speed;
 - .2 proportional integral derivative (PID) speed loop regulators with an auto tune function as well as manual adjustments; PID set point controllers to allow pressure or flow signals to be connected to VFD, using microprocessor in VFD for closed loop control; includes 250 ma of 24 VDC auxiliary power and capability of loop powering a transmitter supplied by others; two parameter sets for first PID that allow sets to be switched via a digital input, serial communications or from keypad for night setback, summer/winter set points, etc; independent, second PID loop that can utilize second analogue input and modulate analogue outputs to maintain set point of an independent process (ie. valves, dampers, etc.); set points, process variables, etc. to be accessible from serial communication network;
 - .3 programmable analogue inputs that accept current or voltage signals.

- .4 programmable analogue outputs (0-20ma or 4-20 ma), that may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data;
 - .5 programmable digital inputs;
 - .6 programmable digital Form-C relay contact outputs for programmable on and off delay times and adjustable hysteresis; rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS;
 - .7 run permissive circuit - for damper or valve control; dry contact closure that will signal damper to open (VFD motor does not operate); when damper is fully open, a normally open dry contact (end-switch) closes; closed end-switch is wired to a VFD digital input and allows motor operation; two separate safety interlock inputs, when either is opened, motor to coast to stop, and damper to close;
 - .8 two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps;
 - .9 fireman's override input - upon receipt of a contact closure from fireman's control station, VFD operates in one of two modes: operate at a programmed predetermined fixed speed or operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback; mode overrides all other inputs (analogue/digital, serial communication and keypad commands), except customer defined safety run interlock, and forces motor to run in one of the two modes; "Override Mode" to be displayed on control panel; upon removal of override signal, VFD resumes normal operation.
- .2 Operator Control Panel:
- .1 front mounted plug-in operator control panel consisting of keypad, multi-line backlit LCD display for programming and fault diagnostics;
 - .2 keys (switches) for HAND, OFF, AUTO, and manual speed control INCREASE/DECREASE;
 - .3 menu navigation and parameter selection keys for custom programming;
 - .4 date and time clock - clock to have a battery backup with 10 years minimum life span; clock to be used to date and time stamp faults and record operating parameters at time of fault; if battery fails VFD I automatically reverts to hours of operation since initial power up; clock also to be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays; VFD to have a digital input that allows an override to time clock (when in off mode) for a programmable time frame; four (4) separate, independent timer functions that have both weekday and weekend settings;
 - .5 parameter names, fault messages, warnings and other information to be displayed in complete words or standard abbreviations to allow user to understand what is being displayed without use of a manual or cross reference table, as follows:
 - .1 "HAND" position to start drive and modify reference frequency by use of INCREASE/DECREASE keys;
 - .2 "OFF" position stops drive;
 - .3 "AUTO" position allows drive to be started or stopped using whichever remote start/stop command configured; drive speed controlled by external speed reference input or by PID controller.
 - .4 applicable operating values to be capable of being displayed in engineering (user) units; operating displayed include:
 - .1 Output Frequency;
 - .2 Motor Speed (RPM, %, or Engineering units);

- .3 Motor Current;
- .4 Drive Temperature;
- .5 DC Bus Voltage;
- .6 Output Voltage.

2.05 Protective Functions

- .1 For each programmed warning and fault protection function, keypad displays a message in complete words or standard abbreviations.
- .2 VFDs include metal oxide varistors (MOV's) for phase to phase and phase to ground line voltage transient protection.
- .3 Short circuit current rating of 100,000 amps to be provided per UL 508C without relying on line fuses.
- .4 Ground fault protection, motor phase loss protection and phase unbalance protection to be provided. Single phase protection to be provided on input and output.
- .5 VFDs to provide electronic motor overload protection qualified per UL 508C.
- .6 Protection to be provided for AC line or DC bus overvoltage at 130% of maximum rated or undervoltage at 65% of minimum rated.
- .7 Stall protection to be programmable to provide a warning or stop VFD after motor has operated above a programmable torque level for a programmed time limit.
- .8 Underload protection to be programmable to provide a warning or stop VFD after motor has operated below a selected underload curve for a programmed time limit.
- .9 Overtemperature protection to provide a warning if power module temperature is less than 5C° (9F°) below overtemperature trip level.
- .10 Input terminal to be provided for connecting a motor thermistor (PTC type) to drive's protective monitoring circuitry. An input to also be programmable to monitor an external relay or switch contact.
- .11 VFDs through 56 kW (75HP) to be protected from damage from input and output power miss-wiring. VFD to sense this condition and display an alarm on control panel.
- .12 EMI / RFI filters to be provided as per standard EN 61800-3.
- .13 dv/dt long lead filter (LRC) to protect power system network.
- .14 Automatic reset feature to automatically reset selected faults and attempt to restart drive based on control parameters such as adjustable time delays, number of restart attempts and duration of restart attempts. Faults include following:
 - .1 Overcurrent;
 - .2 Overvoltage;
 - .3 Undervoltage;
 - .4 Analogue input signal reference loss;
 - .5 External fault.
- .15 Additional built-in protection circuits include:

- .1 Overcurrent trip limit;
- .2 Undervoltage trip limit;
- .3 Microprocessor fault;
- .4 Keypad control panel loss;
- .5 Serial communication loss;
- .6 External fault interlock inputs;
- .7 Adjustable output frequency and motor speed limits;
- .8 Pass code parameter change protection;
- .9 Keypad operator control lockout.

2.06 Manual Bypass

- .1 Bypass system to be a fully operational horsepower rated manual system for full speed operation without VFD, with following components:
 - .1 VFD and By-pass output contactors, mechanically and electrically interlocked to allow only one mode of operation at one time;
 - .2 service switch or contactor to isolate VFD from supply;
 - .3 VFD input fuses;
 - .4 door mounted VFD/OFF/BY-PASS selector switch;
 - .5 VFD ON and BY-PASS ON indicator lights;
 - .6 door mounted HAND/OFF/AUTO switch if Hand operation is unavailable at VFD control panel;
 - .7 terminals for external customer safety interlocks.
- .2 Bypass designs, which have no VFD only fuses, or that incorporate fuses common to both VFD and bypass are not acceptable.
- .3 Door interlocked padlockable fused disconnect switch that supplies power to VFD and bypass, and disconnects input power from drive, bypass and all internally mounted devices.

2.07 Communications

- .1 VFD to be complete with communications connections of integrated RS-485 port suitable to allow for VFD to be controlled, supervised, monitored and programmed from one remote control panel or PC with VFD system Windows based application software.
- .2 Communications protocol to be industry standard compatible to BAS of building. Coordinate exact requirements with Mechanical Divisions controls contractor and BAS vendor to ensure that appropriate interface module is supplied for drive system to communicate with BAS being used in building with interface capability to include serial communication standard protocols as follows:
 - .1 ModBus;
 - .2 Johnson Controls Metasys N2;
 - .3 Siemens Building Technologies FLN;

- .4 BACnet.
- .3 Serial communication to be used for drive setup, diagnostic analysis, monitoring and control with capabilities to include, but not be limited to:
 - .1 run-stop control;
 - .2 speed set adjustment;
 - .3 proportional/integral/derivative PID control adjustments;
 - .4 current limit;
 - .5 accel/decel time adjustments;
 - .6 ability to lock and unlock control panel keypad;
 - .7 capability of allowing BAS to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature;
 - .8 monitoring relays output status, and digital input status and analogue output values;
 - .9 transmitting diagnostic warning and fault information over communications bus to BAS or other monitoring system;
 - .10 remote fault reset.
- .4 Serial communication and Windows based software to be used for drive setup, diagnostic analysis, monitoring and control. Software to provide real time graphical displays of drive performance. VFD software communication capabilities include, but not be limited to:
 - .1 system ON/OFF;
 - .2 system status;
 - .3 Suitable input for speed control;
 - .4 run-stop control;
 - .5 ability to force unit to bypass;
 - .6 ability to lock and unlock control panel keypad;
 - .7 allowing BAS to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and logic board temperature;
 - .8 monitoring relays output status, and all digital input status;
 - .9 transmitting diagnostic warning and fault information over communications bus to BAS or other monitoring system;
 - .10 remote fault reset;
 - .11 keypad "Hand" or "Auto" selected, and status indications and settings transmitted over serial communications bus;
 - .12 monitor if motor is running under load in both VFD and bypass (proof of flow) in VFD mode over serial communications or Form-C relay output;
 - .13 minimum of 40 field parameters to be capable of being monitored in bypass mode.

2.08 Warranty

- .1 VFDs to be warranted free from defective labour and materials for period of 36 months from date of Substantial Performance of the Work. Include for initial one year Contract warranty and an additional 2 year extended warranty direct to Owner. Extended warranty terms and conditions are to be identical to one year Contract warranty, and extended warranty period is to commence day Contract warranty expires.

2.09 Site Services, Training, and Maintenance Manuals

- .1 Provide onsite inspection, testing, start up and verification work of VFDs and filters by manufacturer's authorized technician. Allow a minimum of 1/2 day per system. Also include for a second visit to site of one (1) day duration to train operating personnel in operation and maintenance of drives. Provide verification reports and supply soft copy of system programming parameters.
- .2 Upon completion of installation, supplier of VFDs to supply minimum one hard copy of complete sets of service and maintenance manuals including wiring and connection diagrams. Include for digital copy loaded onto a USB type flash drive.
- .3 Provide system training and instructions on operating and maintenance procedures. Refer to additional requirements in General Instructions section and Division 01.
- .4 Include for manufacturer's authorized technician to be in attendance to assist Commissioning Agent during commissioning process.

2.10 Acceptable Manufacturers

- .1 Acceptable VFD manufacturers are:
 - .1
 - .2 Danfoss;
 - .3 ABB;
 - .4 Schneider Electric (Square D);
 - .5 Rockwell Automation;
 - .6 Eaton Cutler Hammer;
 - .7 Siemens Electric;
 - .8 Control Techniques.

3 Execution

3.01 Installation of Variable Frequency Drives

- .1 Provide variable frequency drives for motorized equipment in accordance with drawing requirements. Coordinate requirements for conductors and connections with Electrical Divisions Contractor.
- .2 Ensure that variable speed drives supplied are products of same manufacturer.
- .3 Unless otherwise noted on drawings or in Part 2 of this Section, include minimally, a manual bypass with each VFD. Supply electronic bypass with VFDs specifically noted and/or scheduled on drawings.
- .4 Ensure wire length between VFD and motor is less than 15 m (50') with properly sized conductors.

- .5 Install VFDs in accordance with manufacturer's instructions. Ensure that VFDs installation include upstream protection, either fuses or circuit breakers in accordance with VFD manufacturer's recommendations and local electrical code requirements. Advise Electrical Divisions Contractor of these requirements in addition to required conductors and connections. Provide required control wiring and connections.
- .6 Review VFD and related connected motor installation. Provide local disconnect to VFD in accordance with local governing code requirements.
- .7 Mount VFDs operating controls/display at approximately 1.5 m (5') above finished floor level, unless otherwise directed by Consultant. Provide dual back to back C-channel support system from floor to ceiling, complete with cross bracing to form a solid backing for VFD mounting at required locations.
- .8 Properly support VFDs. Coordinate exact locations on site with Consultant.
- .9 Where VFDs are required for custom made air handling units VFDs to be supplied, factory mounted on fan cabinets, and "load" side connected to fan motors by air handling unit manufacturer. "Line" side power wiring to these VFDs to be provided as part of Electrical Divisions work.
- .10 Where VFDs are required for commercial fans, mount each VFD generally where shown but with exact location to ensure that VFD is accessible in accordance with local governing electrical code requirements. "Line" and "load" side power wiring to these VFD's to be provided as part of Electrical Divisions work.
- .11 Where VFDs are required for pumps, mount each VFD generally where shown but with exact location to ensure that VFD is accessible in accordance with local governing electrical code requirements. "Line" and "load" side power wiring to these VFDs to be provided as part of Electrical Divisions work.
- .12 Install harmonic mitigation filter equipment as follows:
 - .1 in accordance with manufacturer's recommended installation practices and to comply with applicable local governing codes;
 - .2 provide each VFD as specified in per Part 2, with a harmonic filter sized as per manufacturer's rating table to match rating of connected VFD;
 - .3 mount harmonic filters sized up to 110 kW (150 HP) typically to wall/ceiling construction using suitable brackets, metal C-channel framework and vibration isolators assemblies, ensuring full support of units acceptable to local governing authorities;
 - .4 mount harmonic filters sized greater than 110 kW (150 HP) typically to floor mounted concrete pads with suitable vibration isolators in accordance with local governing building codes;
 - .5 ensure that adequate ventilation and space for access is provided;
 - .6 review exact locations with Consultant prior to installation;
 - .7 coordinate with Electrical Division Contractor to ensure units are connected complete to line side supply feed and to VFD in accordance with VFD manufacturer's instructions for standalone VFDs and VFD system with bypass; include required control wiring and connections.
- .13 Ground and bond equipment as per local governing electrical code requirements and manufacturer's instructions.
- .14 Provide engraved lamacoid nameplate identifying each piece of equipment. Review exact nomenclature with Consultant.
- .15 Be responsible for ensuring that VFDs, harmonic filters and connected motors are properly installed, connected, tested in proper working order and operation verified.

3.02 Testing, Start-Up, and Verification

- .1 When installation of VFDs are complete, arrange for VFD manufacturer/supplier to:
 - .1 supply factory authorized technician at site for minimum of 4 hours per system to examine installation and connection of each VFD, and to perform start-up and set-up procedures in conjunction with equipment start-up and testing procedures;
 - .2 supply factory authorized technician at site for minimum of one 8 hour day to train Owner's personnel on VFD operating and maintenance procedures;
 - .3 prepare and submit letter to certify that VFDs have been properly installed, tested and adjusted, and are in proper operating condition;
 - .4 submit list of start-up and testing parameters for uploading for future use by Owner.
- .2 Start-up data entries to include motor nameplate power, speed, voltage, frequency and current.
- .3 Inspect VFDs and accessories for verification of proper operation and installation.
- .4 Inspect interface wiring to BAS for verification of proper operation and installation.
- .5 Verification of wire terminations to VFDs and bypass and to operational circuitry.
- .6 Installation verification of VFD, bypass and motor being driven for proper operation and reliability.
- .7 Verification that connections and communications to BAS or other monitoring/remote control system are of proper operation and installation and of full communications compatibility.
- .8 Measurement for verification of proper operation on each of following items:
 - .1 Motor voltage and frequency;
 - .2 Verification of proper motor operation;
 - .3 Control input for proper building automation system interface and control calibration.
- .9 Calibration check for following set points (and adjustment as necessary):
 - .1 minimum speed;
 - .2 maximum speed;
 - .3 acceleration and deceleration rates.
- .10 Verify harmonic compliance with onsite field measurements of both voltage and current harmonic distortion at point of common coupling-input terminals of harmonic mitigating equipment with and without equipment operating. Utilize recording type Fluke 41 or equivalent harmonics analyser displaying individual and total harmonic currents and voltages.
- .11 Document testing and results in a report signed by a Professional Engineer licensed in the Place of Work and authorized by system manufacturer. Include for minimum 3 hard copies and electronic copy of report to be submitted to Consultant for review.
- .12 Additionally, refer to applicable installation, testing, coordination and verification requirements in Electrical Divisions Sections.

End of Section

1 General

1.01 Application

- .1 This Section specifies firestopping and smoke seal requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 Submittals

- .1 Submit a product data sheet and a WHIMIS sheet for each firestopping and smoke seal product.
- .2 Submit for review, full company name and experience of proposed firestopping and smoke seal system applicator.
- .3 Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

1.03 Quality Assurance

- .1 Comply with firestopping and smoke seal product manufacturer's recommendations regarding suitable environment conditions for product installation.

2 Products

2.01 Firestopping and Smoke Seal System Materials

- .1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with ULC S115 and ULC S101 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 fire resistance rating of surrounding fire rated 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 firestopping manufacturer's recommendations and ULC tested assembly.
- .3 Pipe insulation forming part of a fire and smoke seal assembly is specified in Section entitled Mechanical Insulation.
- .4 Acceptable manufacturers are:
 - .1 A/D Fire Protection Systems "FIREBARRIER";
 - .2 Tremco Inc. Fire Protection Systems Group "TREMSTOP";
 - .3 3M Canada;
 - .4 Hilti (Canada) Ltd. Firestop Systems;
 - .5 Specified Technologies Inc.

3 Execution

3.01 Installation of Firestopping and Smoke Seal Materials

- .1 Where mechanical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of ULC S115, ULC S101, and other governing authorities to seal penetrations.
- .2 Abide by following requirements:
 - .1 Examine substrates, openings, voids, adjoining construction and conditions under which firestop and smoke seal system is to be installed. Confirm compatibility of surfaces.

- .2 Verify penetrating items are securely fixed and properly located with proper space allowance between penetrations and surfaces of openings.
- .3 Report any unsuitable or unsatisfactory conditions to Contractor and Consultant in writing, prior to commencement of work. Commencement of work will mean acceptance of conditions and surfaces.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces. Remove stains on adjacent surfaces.
- .3 Conform to following application requirements:
 - .1 Prime substrates in accordance with product manufacturer's written instructions.
 - .2 Provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing.
 - .3 Tool or trowel exposed surfaces to a neat, smooth, and consistent finish.
 - .4 Remove excess compound promptly as work progresses and upon completion.
 - .5 At fusible link damper locations, seal perimeter of angle iron framing on both sides of wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal.
- .4 Notify Consultant when work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of work by Municipal Building Inspector prior to concealing or enclosing work. Make any corrections required.
- .5 On completion of firestopping and smoke sealing installation, submit a Letter of Assurance to Consultant certifying the firestopping and smoke sealing installation has been carried out throughout the building to mechanical service penetrations and that installation has been done in strict accordance with requirements of Provincial Building Code, any applicable local Municipal Codes, ULC requirements, and manufacturer's instructions.

End of Section

1 General

1.01 Application

- .1 This Section specifies vibration isolation product requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 Submittals

- .1 Submit copies of manufacturer's product data sheets for products specified in this Section. Product data sheets are to include product characteristics, limitations, dimensions, finishes, and installation recommendations.
- .2 Submit a letter from vibration isolation manufacturer to certify correct installation of products, as specified in Part 3 of this Section.

1.03 Seismic Restraint Requirements

- .1 Where applicable to the project, refer to Section 20 05 48.16 "Seismic Controls for Mechanical Systems" for requirements for the use of a Seismic Consultant and seismic restraint requirements required for vibration isolated materials and equipment.

2 Products

2.01 General

- .1 Vibration isolation products are to be in accordance with the most recent edition of the ASHRAE Handbook and/or as indicated on drawings, schedules, details, and as specified below.
- .2 Springs are to be stable, colour coded, selected to operate at no greater than $\frac{2}{3}$ solid load, designed in accordance with Society of Automotive Engineers Handbook Supplement 9 entitled Manual on Design and Application of Helical and Spiral Springs, and with spring diameters in accordance with manufacturer's recommendations to suit static deflection and maximum equipment load.
- .3 Steel components of isolation products not exposed to the weather or moisture are to be zinc plated. Steel components of isolation products exposed to the weather or in a damp, moist environment are to be factory painted with rust inhibiting primer and 2 coats of neoprene.
- .4 Where weight of isolated equipment may change significantly due to draining or filling with a liquid, vibration isolators are to be equipped with limit stops to limit spring extensions.
- .5 Seismic rated isolators and snubbers are to be listed, rated, and approved by State of California Office of Statewide Health and Planning Department (O.S.H.P.D.) and carry an O.S.H.P.D. pre-approved number. Seismic restraints supplied with vibration isolation are to meet requirements specified in Section entitled Seismic Control and Restraint.
- .6 Flexible piping connections to vibration isolated equipment are specified in the appropriate piping sections of the Specification.

2.02 Isolation Pads

- .1 Sandwich type pads, 20 mm ($\frac{3}{4}$ ") nominal thickness, selected for 3.2 mm (1/8") static deflection unless otherwise specified, consisting of 2 waffle type or ribbed 50 durometer neoprene pads permanently bonded to a minimum #10 gauge steel plate, and complete with rubber bushed bolt holes and equipment anchor bolts with neoprene isolation grommets.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type NSN;
 - .2 The VMC Group Vibration Mounting & Controls Inc. (Korfund-Dynamics) "SHEAR-FLEX PLATES";
 - .3 Kinetics Noise Control Vibron Products Group Type NGS/NGD;

- .4 Mason Industries Inc. Type SW/S/SW with HG Bolt Insertion Washers;
- .5 J. P. America Inc. Type JSJ.

2.03 Rubber Floor Isolators

- .1 Captive, bridge bearing quality neoprene mount selected for a minimum 4 mm (0.15") static deflection unless otherwise specified, with an integral ductile iron housing and integral equipment anchor bolt.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type R;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type RSM;
 - .3 Kinetics Noise Control Vibron Products Group Type RQ;
 - .4 Mason Industries Inc. Type BR;
 - .5 J. P. America Inc. Type TRM.

2.04 Spring Floor Isolators

- .1 Seismically rated captive spring mount isolator complete with levelling bolts, upper and lower neoprene spring cups, neoprene cushion, ductile iron housing, neoprene sound pads, and neoprene isolation grommets for securing bolts.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type SFS;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type AMSR;
 - .3 Kinetics Noise Control Vibron Products Group Type FLSS;
 - .4 Mason Industries Inc. Type SSLFH;
 - .5 J. P. America Inc. Type TSO-C-SC.

2.05 Open Spring Mounts

- .1 Base mount free-standing assemblies, each complete with a stable colour coded steel spring welded in place, drilled mild steel mounting plate bonded to a ribbed rubber or neoprene acoustical pad, and an external 16 mm (5/8") diameter level adjustment bolt.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type FS;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Type A;
 - .3 Kinetics Noise Control Vibron Products Group Type FDS;
 - .4 Mason Industries Inc. Type SLFH;
 - .5 J. P. America Inc. Type TSO.

2.06 Closed Spring Mounts

- .1 Base mount free-standing enclosed assemblies, each complete with stable colour coded spring(s), 2 piece cast housing, non-binding rubber horizontal stabilizers, a ribbed rubber or neoprene acoustical pad bonded to base of the closed housing, and an external level adjustment bolt.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type CM;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Types B and C;
 - .3 Kinetics Noise Control Vibron Products Group Type FLS;
 - .4 Mason Industries Inc. Type C;
 - .5 J. P. America Inc. Type TSC.

2.07 Totally Retained Spring Mounts

- .1 Base mount free-standing enclosed and retained assemblies to limit both vertical and lateral movement of mounted equipment, each complete with stable colour coded spring(s), drilled welded steel housing and top plate, ribbed rubber or neoprene acoustical pad bonded to bottom of housing, vertical limit adjusting hardware, and a level adjustment bolt.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type CSR;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Type MS;
 - .3 Kinetics Noise Control Vibron Products Group Type SM;
 - .4 Mason Industries Inc. Type SLRSO;
 - .5 J. P. America Inc. Type TSR.

2.08 Spring Hangers

- .1 Welded steel plate housing with top and bottom rod mounting holes and spring retainer, neoprene double deflection isolation element, stable colour coded spring, and heavy-duty rubber washers.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type SHR-SN;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Series HRSA;
 - .3 Kinetics Noise Control Vibron Products Group. Type SRH;
 - .4 Mason Industries Inc. Type 30N;
 - .5 J. P. America Inc. Type TSH.

2.09 Neoprene Hanger Isolators

- .1 Neoprene double deflection rod isolators with steel housing and hanger rod bushing, selected for a minimum 4 mm (0.15") static deflection unless otherwise specified.
- .2 Acceptable products are:

- .1 Vibro-Acoustics Ltd. Type NH;
- .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type HR;
- .3 Kinetics Noise Control Vibron Products Group Type RH;
- .4 Mason Industries Inc. Type HD or WHD;
- .5 J. P. America Inc. Type TRH.

2.10 Concrete Inertia Type Equipment Base

- .1 Welded steel bases, each complete with a structural black steel channel frame, concrete reinforcing rods, and brackets for spring mounts welded to frame.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type CIB;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type CPF;
 - .3 Kinetics Noise Control Vibron Products Group. Type CIB;
 - .4 Mason Industries Inc. Type KSL;
 - .5 J. P. America Inc. Type BCI.

2.11 Steel Equipment Base

- .1 Fully welded structural steel equipment and motor support bases, each complete with a wide flange steel frame, full depth cross members, brackets for spring mounts, and adjustable motor slide rails.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type SB;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type WFB;
 - .3 Kinetics Noise Control Vibron Products Group Type SFB;
 - .4 Mason Industries Inc. Type WFSL;
 - .5 J. P. America Inc. Type BWS (with motor slide rail).

2.12 Combination Steel /Concrete Inertia Equipment Base

- .1 Welded steel bases with a structural black steel channel frame, concrete reinforcing rods, bottom sheet steel pan, brackets for spring mounts welded to frame and adjustable motor slide rails.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type CIB (with motor slide rails);
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type WPF (with motor slide rails);
 - .3 Kinetics Noise Control Vibron Products Group Type CIB (with motor slide rails);
 - .4 Mason Industries Inc. Type BMK or K;
 - .5 J. P. America Inc. Type BSI (with motor slide rail).

2.13 Slung Steel Base

- .1 Slung steel bases of structural members with gusset plates welded to ends and complete with adjustable motor slide rails and vertical section size to suit equipment's motor power output.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type SS;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type CPF;
 - .3 Kinetics Noise Control Vibron Products Group Type CIB-H;
 - .4 Mason Industries Inc. Type MSL.

2.14 Continuous Rail Type Isolation for Roof Mounted Equipment

- .1 Continuous rooftop isolation shipped completely assembled, consisting of:
 - .1 galvanized steel sections formed to fit roof curb and associated equipment with a flexible air and weather seal joining upper and lower rail sections;
 - .2 stable springs, cadmium plated and selected to provide minimum deflection with 50% additional travel to solid;
 - .3 neoprene cushioned and wind restraints allowing 6 mm (1/4") movement before engaging and resisting wind loads in any lateral direction.
- .2 Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Vibro-Acoustics Type RTR;
 - .2 The VMC Group Vibration Mounting and Controls (Korfund-Dynamics) Type RTIR;
 - .3 Kinetics Noise Control Vibron Products Group Type KSR;
 - .4 Mason Industries Inc. Type RSC;
 - .5 J. P. America Inc. Type BRC.

3 Execution

3.01 Installation of Vibration Isolation Materials

- .1 Unless otherwise stated in the drawings, schedules and/or typical details, vibration isolation is to be provided for all mechanical equipment as per the recommendations contained within in the most recent edition of the ASHRAE Handbook.
- .2 Supply to vibration isolation product manufacturer or supplier a copy of a "reviewed" shop drawing or product data sheet for each piece of equipment to be isolated and dimensioned pipe layouts of associated piping to be isolated.
- .3 Unless otherwise specified, vibration isolation products are to be product of one manufacturer.
- .4 Ensure vibration isolation manufacturer coordinates material selections with equipment provided in order to ensure adherence to performance criteria. Allow for expansion and contraction when material is selected and installed.
- .5 Unless otherwise indicated, install isolation materials for base mounted equipment on concrete housekeeping pad bases which extend at least over the full base and isolated area of the isolated equipment. Additional requirements are as follows:

- .1 block and shim bases level so ductwork and piping connections can be made to a rigid system at proper operating level, before isolated adjustment is made, and ensure there is no physical contact between isolated equipment and building structure;
- .2 steel bases are to clear the sub-base by 25 mm (1");
- .3 concrete bases are to clear the sub-base by 50 mm (2").
- .6 Isolate piping larger than 25 mm (1") dia. directly connected to motorized and/or vibration isolated equipment with 25 mm (1") static deflection spring hangers at spacing intervals in accordance with following:
 - .1 for pipe less than or equal to 100 mm (4") dia. – first 3 points of support;
 - .2 for pipe 125 mm (5") to 200 mm (8") dia. – first 4 points of support;
 - .3 for pipe equal to or greater than 250 mm (10") dia. – first 6 points of support;
- .7 First point of isolated piping support is to have a static deflection of twice the deflection of the isolated equipment but maximum 50 mm (2").
- .8 Secure top of spring hanger frame rigidly to structure, and do not install spring hangers in concealed locations.
- .9 Where it is impossible to use at least 2 spring hangers, provide Senior Flexonics Ltd. Style 102 (or 102-U as required) or equal, twin sphere, moulded rubber flexible connection assemblies, selected by manufacturer and suitable in all respects for intended application, and complete with required nipples and connections to provide proper vibration isolation.
- .10 Isolate designated piping risers at floor support points in accordance with drawing detail and/or where indicated on drawings.
- .11 Erect roof curb vibration isolation in accordance with instructions shipped with assembly. Match vibration isolation with associated roof top unit and orient isolation as identified by manufacturer to ensure proper loading and optimum performance. Caulk top of roof curb with 2 beads of caulking provided and centre isolation assembly onto roof curb and, unless otherwise noted, screw in place with 50 mm (2") lag screws at 900 mm (36") O.C. Position gasket on top rail or alternatively, caulk with 2 beads of caulking provided and orient and lower roof top unit onto isolation rails and, unless otherwise noted, screw unit in to top rail with 25 mm (1") lag screws at 900 mm (36") O.C. After roof top unit is secured in place, but before damageable work is installed, spray each isolated equipment assembly with water and correct any water leaks.
- .12 For control wiring connections to vibration isolated equipment ensure flexible metallic conduit with 90° bend is used for conduit 25 mm (1") dia. and smaller, and for conduit larger than 25 mm (1") dia., use Crouse Hinds EC couplings. Connections are to be long enough so that conduit will remain intact if equipment moves 300 mm (12") laterally from its installed position, and flexible enough to transmit less vibration to structure than is transmitted through vibration isolation. Coordinate these requirements with mechanical trades involved. If electrical power connections are not made in a similar manner as part of the electrical work, report this fact to Consultant.
- .13 Arrange and pay for vibration isolation product manufacturer to visit site to inspect installation of his equipment. Perform revision work required as a result of improper installation. When vibration isolation equipment manufacturer is satisfied with the installation, obtain and submit a letter stating manufacturer has inspected the installation and equipment is properly installed.
- .14 Refer to Section entitled Seismic Control and Restraint for requirements pertaining to seismically restrained vibration isolation.

End of Section

1 General

1.01 Section Includes

- .1 This Section specifies mechanical system testing, adjusting, and balancing requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 Definitions

- .1 "Agency" – means agency to perform testing, adjusting and balancing work.
- .2 "TAB" – means testing, adjusting and balancing to determine and confirm quantitative performance of equipment and systems and to regulate specified fluid flow rate and air patterns at terminal equipment, e.g., reduce fan speed, throttling, etc.
- .3 "hydronic systems" – includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.
- .4 "air systems" – includes outside air, supply air, return air, exhaust air, and relief air systems.
- .5 "flow rate tolerance" – means allowable percentage variation, minus to plus, of actual flow rate values in Contract Documents.
- .6 "report forms" – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form permanent record to be used as basis for required future testing, adjusting and balancing.
- .7 "terminal" – means point where controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- .8 "main" – means duct or pipe containing system's major or entire fluid flow.
- .9 "submain" – means duct or pipe containing part of the systems' capacity and serving 2 or more branch mains.
- .10 "branch main" – means duct or pipe servicing 2 or more terminals.
- .11 "branch" – means duct or pipe serving a single terminal.

1.03 Submittals

- .1 Within 30 days of work commencing at site, submit name and qualifications of proposed testing and balancing agency in accordance with requirements of article entitled Quality Assurance below.
- .2 Submit sample test forms, if other than those standard forms prepared by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB), are proposed for use.
- .3 Submit a report by Agency to indicate Agency's evaluation of mechanical drawings with respect to service routing and location or lack of balancing devices. Include set of drawings used and marked-up by Agency to prepare report.
- .4 Submit a report by Agency after each site visit made by Agency during construction phase of this Project.
- .5 Submit a draft report, as specified in Part 3 of this Section.
- .6 Submit a final report, as specified in Part 3 of this Section.
- .7 Submit a testing and balancing warranty as specified in Part 3 of this Section.
- .8 Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.04 Quality Assurance

- .1 Employ services of an independent testing, adjusting, and balancing agency meeting qualifications specified below, to be single source of responsibility to test, adjust, and balance building mechanical systems to produce design objectives.
- .2 Testing, adjusting and balancing of complete mechanical systems is to be performed over entire operating range of each system in accordance with 1 of following publications:
 - .1 National Standards for a Total System Balance published by Associated Air Balance Council;
 - .2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by National Environmental Balancing Bureau;
 - .3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications.

1.05 Acceptable Service Companies

- .1 Acceptable service companies are as follows:
 - .1 Air Audit;
 - .2 Clarke Balancing;
 - .3 Airwaso;
 - .4 Dynamic Flow Balancing;
 - .5 Air Velocities Control;
 - .6 Flowset Balancing.

2 Products – Not Used

3 Execution

3.01 Scope of Work

- .1 Perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of fluid quantities of mechanical systems as required to meet design specifications and comfort conditions, and recording and reporting results.
- .2 Mechanical systems to be tested, adjusted and balanced include:
 - .1 TAB of domestic water systems (all piping extended from Municipal main) is to include:
 - .1 domestic hot water recirculation piping;
 - .2 tempered water piping flows.
 - .2 TAB of heating systems is to include piping and equipment fluid temperatures, flows and control, and if TAB is not done during heating season, a follow-up site visit during heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
 - .3 TAB of cooling systems is also to include piping and equipment fluid temperatures, flows and control, and if TAB is not done during cooling season, a follow-up site visit during cooling season will be required to confirm proper flows and temperatures, and any required system "fine".

- .4 TAB of air handling systems is to include equipment and ductwork air temperatures, capacities and flows.

3.02 Testing, Adjusting, and Balancing

- .1 Conform to following:
- .1 as soon as possible after award of Contract, Agency is to carefully examine a set of mechanical drawings with respect to routing of services and location of balancing devices, and is to issue a report listing results of the evaluation;
 - .2 set of drawings examined by Agency is to be returned with evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices;
 - .3 after review of mechanical work drawings and specification, Agency is to visit site at frequent, regular intervals during construction of mechanical systems, to observe routing of services, locations of testing and balancing devices, workmanship, and anything else that will affect testing, adjusting and balancing;
 - .4 after each site visit, Agency is to report results of site visit indicating date and time of visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing;
 - .5 testing, adjusting and balancing is not to begin until:
 - .1 building construction work is substantially complete and doors have been installed;
 - .2 mechanical systems are complete in all respects, and have been checked, started, adjusted, and then successfully performance tested.
 - .6 mechanical systems to be tested, adjusted and balanced are to be maintained in full, normal operation during each day of testing, adjusting and balancing;
 - .7 obtain copies of reviewed shop drawings of applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences;
 - .8 Agency is to walk each system from system "head end" equipment to terminal units to determine variations of installation from design, and system installation trades will accompany Agency;
 - .9 Agency is to check valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment;
 - .10 wherever possible, Agency is to lock balancing devices in place at proper setting, and permanently mark settings on devices;
 - .11 Agency is to leak test ductwork as specified in Section entitled HVAC Air Distribution in accordance with requirements of SMACNA "HVAC Air Duct Leak Test Manual", coordinate work with work of aforementioned Sections, provide detailed sketch(es) to Sheet Metal Contractor and Consultant identifying ductwork not in accordance with acceptable leakage values specified in aforementioned Sections, and retest corrected ductwork;
 - .12 Agency is to balance systems with due regard to objectionable noise which is to be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at design conditions, Agency is to immediately report problem and submit data, including sound readings, to permit an accurate assessment of noise problem to be made;
 - .13 Agency is to check supply air handling system mixing plenums for stratification, and where variation of mixed air temperature across coils is found to be in excess of $\pm 5\%$ of design requirements, Agency is to report problem and issue a detail sketch of plenum baffle(s) required to eliminate stratification;
 - .14 Agency is to perform testing, adjusting and balancing to within $\pm 5\%$ of design values, and make and record measurements which are within $\pm 2\%$ of actual values;

- .15 for air handling systems equipped with air filters, test and balance systems with simulated 50% loaded (dirty) filters by providing a false pressure drop;
 - .16 Balance air flow keeping the building slightly positive at 0.01"wc (3Pa) pressure whenever possible to allow doors to properly close.
 - .17 test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8°C (5°F) wet bulb temperature of maximum summer design condition, and within 5.5°C (10°C) dry bulb temperature of minimum winter design condition, and take final temperature readings during seasonal operation.
- .2 Prepare reports as indicated below.
- .1 Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on AABC or NEBB forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in same manner specified for final reports and submit for review.
 - .2 Upon verification and approval of draft reports, prepare final reports organized and formatted as specified below. Use units of measurement (SI or Imperial) as used on Project Documents.
 - .3 Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Report forms complete with schematic systems diagrams and other data are to be consolidated in electronic format as a PDF. PDF file to be indexed and organized into sections, as it applies to the project, as follows:
 - .1 General Information and Summary;
 - .2 Air Systems;
 - .3 Hydronic Systems;
 - .4 Temperature Control Systems;
 - .5 Special Systems.
 - .4 Agency is to provide following minimum information, forms and data in report:
 - .1 inside cover sheet to identify Agency, Contractor, and Project, including addresses, and contact names and telephone numbers and a listing of instrumentation used for procedures along with proof of calibration;
 - .2 remainder of report is to contain appropriate forms containing as a minimum, information indicated on standard AABC or NEBB report forms prepared for each respective item and system;
 - .3 Agency is to include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying equipment, terminals, and accessories;
 - .4 Agency is to include report sheets indicating building comfort test readings for all rooms.
- .3 After final testing and balancing report has been submitted, Agency is to visit site with Contractor and Consultant to spot check results indicated on balancing report. Agency is to supply labour, ladders, and instruments to complete spot checks. If results of spot checks do not, on a consistent basis, agree with final report, spot check procedures will stop and Agency is to then rebalance systems involved, resubmit final report, and again perform spot checks with Contractor and Consultant.
- .4 When final report has been accepted, Contractor is to submit to Owner, in name of Owner, a certificate equal to AABC National Guaranty Certification or a NEBB Quality Assurance Program Bond, and in addition, Contractor is to submit a written extended 2-year warranty from Agency covering one full heating season and one full cooling season, during which time any balancing problems which occur, with exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by

Agency and reported on to Owner, and if it is determined that problems are a result of improper testing, adjusting and balancing, they are to be immediately corrected without additional cost to Owner.

- .5 Balancing Company shall re-visit the site at least once after the system has operated for a period of approximately three months and make necessary adjustments in the airflows / water flows to insure space temperatures meeting the approval of the Owner and Consultant are maintained.

End of Section

1 General

1.01 Application

- .1 This Section specifies insulation requirements common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly.

1.02 Definitions

- .1 "concealed" – means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces.
- .2 "exposed" – means exposed to normal view during normal conditions and operations.
- .3 "mineral fibre" – includes glass fibre, rock wool, and slag wool.
- .4 "domestic water" or "potable water" – means piping extended from building Municipal supply main.

1.03 Submittals

- .1 At least 4 weeks prior to insulation work commencing, submit a sample of each type of insulation (and insulation accessories and finish), in applied form, for review. Mount samples on a plywood board. Identify each product with manufacturer's name and insulation type, and proposed use of insulation. When sample board has been approved, mechanical insulation work is to conform to approved sample board.
- .2 Submit a product data sheet for each insulation system product.
- .3 Submit a fabrication drawing for each custom made cover to indicate material and fabrication details, and a 300 mm (12") square sample of proposed cover material.
- .4 In accordance with Part 3 of this Section, submit a letter from fire rated duct wrap supplier to certifying duct wrap has been properly installed.
- .5 Submit a colour chart for coloured lagging adhesive for canvas jacketed insulation.

1.04 Quality Assurance

- .1 Mechanical insulation is to be applied by a licensed journeyman insulation mechanic, or by an apprentice under direct, daily, on-site supervision of a journeyman mechanic.
- .2 Do not apply insulation unless leakage tests have been satisfactorily completed.
- .3 Ensure surfaces to be insulated are clean and dry.
- .4 Ensure ambient temperature is minimum 13°C (55°F) for at least 1 day prior to application of insulation, and for duration of insulation work, and relative humidity is and will be at a level such that mildew will not form on insulation materials.
- .5 Insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from site.

2 Products

2.01 Fire Hazard Ratings

- .1 Unless otherwise specified, insulation system materials inside building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.

2.02 Thermal Performance

- .1 Unless otherwise specified, thermal performance of insulation is to meet or exceed values given in Tables entitled Minimum Piping Insulation Thickness Heating and Hot Water Systems and Minimum Piping Insulation Thickness Cooling Systems, as stated in ANSI/ASHRAE/IES Standard 90.1 version referenced in Ontario Building Code.

2.03 Pipe Insulation Materials

- .1 Horizontal pipe insulation at hangers and supports are to be equal to Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, pre-moulded, rigid, sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a captive galvanized steel saddle.
- .2 Flexible foam elastomeric is to be closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation with a water vapour transmission rating of 0.10 in accordance with ASTM E96, Procedure B, and required installation accessories. Acceptable products are:
 - .1 Armacell AP/Armaflex SS;
 - .2 IK Insulation Group K-Flex "LS" Self-Seal Pipe Insulation.
- .3 Closed cell foamed glass is to be Pittsburgh Corning "FOAMGLASS", expanded, sectional, rigid sleeve type insulation with a liquid or vapour permeability rating (as per ASTM C240) of 0.00, and a factory applied "PITWRAP SSII" self-sealing jacket.
- .4 Fire rated pre-moulded mineral wool is to be non-combustible, fire-rated, rigid, sectional, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket and compatible with ULC S115 and ULC-S101 firestopping. Acceptable products are:
 - .1 Roxul "Techton 1200";
 - .2 IIG (Johns Manville Inc.) MinWool-1200;
 - .3 Paroc 1200.
- .5 Pre-moulded mineral fibre is to be rigid, sectional, sleeve type insulation to ASTM C547, with a factory applied vapour barrier jacket. Acceptable products are:
 - .1 Johns Manville Inc. "Micro-Lok AP-T Plus";
 - .2 Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket;
 - .3 Manson Insulation Inc. "ALLEY K APT";
 - .4 Owens Corning "Fiberglas" Pipe Insulation.
- .6 Blanket mineral fibre is to be blanket type roll insulation to CGSB 51-GP-11M, 24 kg/m³ (1-½ lb/ft³) density, with a factory applied vapour barrier facing. Acceptable products are:
 - .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.
- .7 Pre-moulded weatherproof jacketed mineral fibre is to be Knauf Insulation "Redi-Klad 1000" sectional, sleeve type pipe insulation with a self-sealing weather-proof jacket and a 100 mm (4") butt joint sealing strip with each section.

2.04 Barrier-Free Lavatory Piping Insulation Kits

- .1 Removable, flexible, reusable, white moulded plastic insulation kits for barrier-free lavatory drain piping and potable water supplies exposed under lavatory.
- .2 Acceptable products are:
 - .1 Truebo "Lav-Guard 2" E-Z Series;
 - .2 Zeston "SNAP-TRAP";
 - .3 McGuire Manufacturing Co. Inc. "ProWrap".

2.05 Equipment Insulation Materials

- .1 Blanket mineral fibre is to be blanket type roll form insulation to ASTM C553, 24 kg/m³ (1-½ lb/ft³) density, with a factory applied vapour barrier facing. Acceptable products are:
 - .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.
- .2 Semi-rigid mineral fibre board is to be roll form, moulded insulation to ASTM C1393, with a factory applied vapour barrier facing consisting of laminated aluminum foil and kraft paper. Acceptable products are:
 - .1 Knauf Fiber Glass Pipe and Tank Insulation;
 - .2 Manson Insulation Inc. "AK FLEX";
 - .3 Johns Manville Inc. Pipe and Tank Insulation "Micro-Flex";
 - .4 Multi-Glass Insulation Ltd. "MULTI-FLEX MF";
 - .5 Owens Corning Pipe and Tank Insulation;
 - .6 Glass-Cell Fabricators Ltd. "R-Flex".
- .3 Closed cell foamed glass is to be Pittsburgh Corning "FOAMGLAS" expanded, rigid board and block type insulation with a liquid or vapour permeability rating (as per ASTM C240) of 0.00.

2.06 Removable/Reusable Insulation Covers

- .1 Valve, etc. covers are to be NO SWEAT reusable insulation wraps with vapour barrier jacket and self-sealing ends and longitudinal seam, with a length to suit the application and an insulation thickness equal to adjoining insulation.
- .2 Custom manufactured equipment covers conforming to shape of item to be insulated, designed to be easily removable and replaceable to suit use and maintenance procedures of particular item, and to provide adequate personnel protection. Covers are to be complete with minimum 95 kg/m³ (6 lb/ft³) density ceramic fibre insulation sewn between minimum 542.5 g/m² (1.8 oz/ft²) weight silicone impregnated fibreglass fabric in a quilted pattern using double stitches made with Kelvar or Teflon coated fibreglass thread. Overlap flaps are to be secured using laces, snaps, or Velcro double stitched in place. Acceptable manufacturers are:
 - .1 Crosby Dewar Inc.;

- .2 Insufab Systems Inc.;
- .3 ADL Insulflex Inc.;
- .4 Firwin Corp.;
- .5 GlassCell Isofab Inc.

2.07 Ductwork System Insulation Materials

- .1 Rigid mineral fibre board is to be pre-formed board type insulation to ASTM C612, 48 kg/m³ (3 lb/ft³) density, with a factory applied reinforced aluminum foil and kraft paper facing. Acceptable products are:
 - .1 Knauf Fiber Glass Insulation Board with FSK facing;
 - .2 Manson Insulation Inc. "AK BOARD FSK";
 - .3 Johns Manville Inc. Type 814 "Spin-Glas";
 - .4 Owens Corning 703.
- .2 Semi-rigid mineral fibre board is to be roll form insulation to ASTM C1393, consisting of cut strips of rigid mineral board insulation glued to an aluminium foil and kraft paper facing. Acceptable products are:
 - .1 Multi-Glass Insulation Ltd. "Multi-Flex MKF";
 - .2 Glass-Cell Fabricators Ltd. "R-FLEX";
 - .3 Owens Corning Pipe and Tank Insulation;
 - .4 Johns Manville Inc. Pipe and Tank Insulation.
- .3 Blanket mineral fibre is to be blanket type roll form insulation to ASTM C553, 24 kg/m³ (1½ lb/ft³) density, 40 mm (1-½") thick, with a factory applied vapour barrier facing. Acceptable products are:
 - .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.
- .4 Pre-moulded calcium silicate is to be rigid block and sheet insulation. Acceptable products are:
 - .1 Johns Manville Inc. "Thermo-12 Gold";
 - .2 Industrial Insulation Group "Thermo-12 Gold".
- .5 Flexible foam elastomeric sheet is to be sheet form, CFC free, closed cell, self-adhering elastomeric nitrile rubber insulation with a water vapour permeability rating of 0.08 in accordance with ASTM E96 Procedure A. Acceptable products are:
 - .1 Armacell "AP/Armaflex SA";
 - .2 IK Insulation Group "K-Flex Duct Wrap", S2S.

2.08 Fire Rated Duct Wrap

- .1 Flexible, non-combustible, blanket type mineral fibre duct wrap completely encapsulated in reinforced foil, suitable for installation with zero clearance to combustibles (for grease ducts), and ULC tested and listed (ULC Designs FRD-17 & 23 for ventilation ducts, ULC Design FRD-19 for kitchen exhaust/grease duct) to facilitate a 2 hour fire resistance rating (76 mm [3"] thick) to kitchen grease exhaust duct in accordance with requirements of NFPA-96, and/or a 1 or 2 hour fire resistance rating (38 mm [1-½"] thick) to ventilation or pressurization ductwork in accordance with requirements of ISO 6944.
- .2 Acceptable manufacturers are:
 - .1 3M Fire Barrier Duct Wrap 615;
 - .2 CL4 Inc. "CL4Fire";
 - .3 Unifrax Corp. "FyreWrap Elite 1.5";
 - .4 Morgan Thermal Ceramics "FireMaster FastWrap XL".

2.09 Insulating Coatings

- .1 Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:
 - .1 anti-condensation coating, "No Sweat-FX";
 - .2 thermal insulating coating, "ThermaLite".

2.10 Insulation Fastenings

- .1 Wire – minimum #15 gauge galvanized annealed wire.
- .2 Wire with Mesh – minimum #15 gauge galvanized annealed wire factory woven into 25 mm (1") hexagonal mesh.
- .3 Aluminium Banding – equal to ITW Insulation Systems Canada "FABSTRAPS" minimum 12 mm (½") wide, 0.6 mm (1/16") thick aluminium strapping.
- .4 Stainless Steel Banding – equal to ITW Insulation Systems Canada "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.
- .5 Duct Insulation Fasteners – weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1-½") square plastic or zinc plated steel self-locking washers.
- .6 Tape Sealant – equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match surface being sealed.
- .7 Mineral Fibre Insulation Adhesive – clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with type of material to be secured, and WHMIS classified as non-hazardous.
- .8 Flexible Elastomeric Insulation Adhesive – Armacell "Armaflex" #520 air-drying contact adhesive.
- .9 Closed Cell Foamed Glass Insulation Adhesive – Pittsburgh Corning PC88 multi-purpose 2-component adhesive.
- .10 Lagging Adhesive – white, brush consistency, ULC listed and labelled, 25/50 fire/smoke rated lagging adhesive for canvas jacket fabric, suitable for colour tinting, complete with fungicide and washable when dry.
- .11 Screws – No. 10 stainless steel sheet metal screws.

2.11 Insulation Jackets and Finishes

- .1 Canvas Jacket Material – ULC listed and labelled, 25/50 fire/smoke rated, roll form, minimum 170 g (6 oz.).
- .2 Roll Form Sheet and Fitting Covers – minimum 15 mm (1/2") thick white PVC, 25/50 fire/smoke rated tested in accordance with ULC S102, complete with installation and sealing accessories. Acceptable products are:
 - .1 Proto Corp. "LoSMOKE";
 - .2 The Sure-Fit System "SMOKE-LESS 25/50";
 - .3 Johns Manville Inc. "Zeston" 300.
- .3 Rigid Aluminium Jacket – equal to ITW Insulation Systems Canada "Lock-on" 0.406 mm (0.016") thick embossed aluminum jacket material to ASTM B209, factory cut to size and complete with polysurlyn moisture barrier and continuous modified Pittsburgh Z-Lock, butt straps with "Fabstraps" to weatherproof the end to end joints, and 2-piece epoxy coated pressed aluminum fittings with weather locking edges.
- .4 Adhesive backed flexible aluminium is to be MFM Building Products Corp. "Flex-Clad 400" roll form sheet material with an aggressive rubberized asphalt adhesive backing, high density polyethylene reinforcement, and an embossed aluminum facing.
- .5 Heat resistant, trowel consistency thermal insulating and finishing cement to CAN/CGSB 51.12, and suitable for the application.
- .6 Foamed glass insulation protective coating is to be Pittsburgh Corning "PITTCOTE 404" flexible acrylic latex weather barrier coating, white unless otherwise specified.
- .7 Flexible foam elastomeric insulation protective coating equal to Armacell "WB Armaflex" weatherproof, water-based latex enamel finish.

3 Execution

3.01 General Insulation Application Requirements

- .1 Unless otherwise specified, do not insulate following:
 - .1 factory insulated equipment and piping;
 - .2 heating piping within radiation unit enclosures, including blank filler sections of enclosures;
 - .3 heating piping in soffits and/or overhang spaces and connected to bare element radiation in spaces;
 - .4 branch potable water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories;
 - .5 exposed chrome plated potable water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories;
 - .6 heated liquid system pump casings, valves, strainers and similar accessories;
 - .7 heating system expansion tanks;
 - .8 fire protection pump casings;
 - .9 manufactured expansion joints and flexible connections;
 - .10 acoustically lined ductwork and/or equipment;
 - .11 factory insulated flexible branch ductwork;

- .12 fire protection system water storage tanks;
- .13 piping unions, except for unions in "cold" category piping.
- .2 Install insulation directly over pipes and ducts, not over hangers and supports.
- .3 Install piping insulation and jacket continuous through pipe openings and sleeves.
- .4 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.
- .5 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect insulation jacketing from the action of condensation at its junction with metal.
- .6 When insulating vertical piping risers 75 mm (3") diameter and larger, use insulation support rings welded directly above lowest pipe fitting, and thereafter at 4.5 m (14.7') centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.
- .7 Where piping and/or equipment is traced with electric heating cable, ensure cable has been tested and accepted prior to application of insulation, and ensure cable is not damaged or displaced during the application of insulation.
- .8 Where existing insulation work is damaged as a result of mechanical work, repair damaged insulation work to Project work standards.
- .9 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover exposed end of insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.
- .10 Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.
- .11 Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in insulation and provide a suitable grommet in the opening.

3.02 Insulation for Horizontal Pipe At Hangers and Supports

- .1 At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply insulation sections to piping installers for installation as pipe is erected.
- .2 For 100 mm (4") diameter and larger heating system piping where roller type hangers and supports are provided, a steel saddle will be tack welded to pipe at each roller hanger or support location. Pack saddle voids with loose mineral wool insulation.

3.03 Pipe Insulation Requirements – Mineral Fibre

- .1 Insulate following pipe inside building and above ground with mineral fibre insulation of thickness indicated:
 - .1 domestic cold water piping, less than 100 mm (4") dia. – 25 mm (1") thick;
 - .2 domestic cold water piping, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;
 - .3 domestic hot water piping, less than 40 mm (1-½") dia. – 25 mm (1") thick;
 - .4 domestic hot water piping, greater than or equal to 40 mm (1½") dia. – 40 mm (1-½") thick;
 - .5 tempered domestic water piping, supply and return, less than 40 mm (1-½") dia. – 25 mm (1") thick;
 - .6 tempered domestic water piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;

- .7 storm drainage piping from roof drains to the point where main vertical risers extend straight down, without offsets, and connect to horizontal underground mains – 25 mm (1") thick;
 - .8 condensate drainage piping from fan coil unit or any other air conditioning system/unit drain pans to main vertical drain risers or to indirect drainage point – 25 mm (1") thick;
 - .9 drainage piping from refrigerated drinking fountains to nearest 75 mm (3") dia. or larger drain pipe – 25 mm (1") thick;
 - .10 chilled water piping, supply and return, less than 100 mm (4") dia. – 25 mm (1") thick;
 - .11 chilled water piping, supply and return, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;
 - .12 chilled glycol solution piping, supply and return, less than 100 mm (4") dia. – 25 mm (1") thick;
 - .13 chilled glycol solution piping, supply and return, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;
 - .14 hot water heating piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
 - .15 hot water heating piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
 - .16 glycol solution heating or heat reclaim piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
 - .17 glycol solution heating or heat reclaim piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
 - .18 chilled domestic cold water piping from remote water cooler(s) to drinking fountain(s) – 40 mm (1-½") thick;
 - .19 piping indicated to be traced with electric heating cable – minimum 50 mm (2") thick;
 - .20 drum drip(s) in dry zone standpipe and/or sprinkler system piping – 50 mm (2") thick;
 - .21 refrigerant suction piping (between compressor and evaporator coil) inside building – 25 mm (1") thick;
 - .22 refrigerant hot gas piping (between compressor and condenser) inside building – 25 mm (1") thick;
 - .23 refrigerant hot gas by-pass piping (between compressor discharge and evaporator coil) inside building – 25 mm (1") thick;
 - .24 air compressor set fresh air intake piping – 25 mm (1") thick;
 - .25 heat pump equipment earthloop piping – 25 mm (1") thick.
- 2 Secure overlap flap of the sectional insulation jacket tightly in place. Cover section to section butt joints with tape sealant.
 - 3 Insulate fittings with sectional pipe insulation mitred to fit tightly, and cover butt joints with tape sealant, or, alternatively, wrap fittings with blanket mineral fibre insulation to a thickness and insulating value equal to the sectional insulation, secure in place with adhesive and/or wire, and cover with PVC fitting covers.
 - 4 Unless otherwise specified, insulate unions, valves, strainers, and similar piping system accessories in "cold" piping with cut and tightly fitted segments of sectional pipe insulation with joints covered with tape sealant, or, alternatively, wrap piping union, valve, strainer, etc., with blanket mineral fibre and cover with PVC covers as for paragraph above.
 - 5 Terminate sectional insulation approximately 50 mm (2") from flange or coupling on each side of flange or coupling. Cover flange or coupling with a minimum 50 mm (2") thickness of blanket mineral fibre insulation wide enough to butt tightly to ends of adjacent sectional insulation. Secure blanket insulation in place and cover with a purpose made PVC coupling cover.

- .6 Drum drips in dry zone sprinkler and/or standpipe system piping will be traced with electric heating cable as part of electrical work, and are generally not shown on drawing(s). Confirm number and size of drum drips required with trade providing piping and include for insulation to suit. Wherever possible drum drips will be located in heated areas.
- .7 Take special care at concealed water rough-in piping at plumbing fixtures to ensure piping is properly insulated. If necessary due to space limitations, use 12 mm (½") thick sectional pipe insulation in lieu of 25 mm (1") thick insulation.
- .8 Insulate seismic restraint hardware such as hanger rods, braces, anchors, etc., directly connected to "cold" category piping and equipment for a distance of 300 mm (12") from piping or equipment with insulation and finish to match pipe or equipment insulation. Coat seismic restraint hardware for a distance of 300 mm (12") from the termination of insulation with Robson Thermal "NO-SWEAT-FX" water based anti-condensation coating.

3.04 Pipe Insulation Requirements – Flexible Foam Elastomeric

- .1 Install flexible elastomeric pipe insulation in strict accordance with manufacturer's published instructions to suit the application, and using adhesive, joint sealants and finish to produce a water-tight installation. Insulate following pipe with flexible elastomeric pipe insulation of thickness indicated:
 - .1 refrigerant suction and hot gas piping outside building – 25 mm (1") thick.

3.05 Pipe Insulation Requirements – Closed Cell Foamed Glass

- .1 Install closed cell foamed glass insulation in strict accordance with manufacturer's published instructions to suit the application, and using adhesive, joint sealants, and jacketing to produce a water-tight installation. Insulate following pipe with closed cell foamed glass of thickness indicated:
 - .1 piping located outside building and indicated to be heat traced – minimum 50 mm (2") thick.

3.06 Pipe Insulation Requirements – Fire Rated Insulation

- .1 Where pipe (inside building and above ground) which is to be insulated as specified above penetrates fire rated construction, provide fire-rated, non-combustible sectional insulation on portion of pipe in fire barrier and for a distance of 50 mm (2") on either side of fire barrier. Insulation thickness is to be as specified, but in any case minimum 25 mm (1").

3.07 Installation of Barrier Free Lavatory Insulation Kits

- .1 Provide manufactured insulation kits to cover exposed drainage and water piping under barrier free lavatories.

3.08 Equipment Insulation Requirements – Blanket Type Mineral Fibre

- .1 Insulate following equipment with mineral fibre blanket type insulation of thickness indicated:
 - .1 chilled water and/or domestic cold water pump casings – 40 mm (1-½") thick;
 - .2 roof drain sumps where inside the building – 25 mm (1") thick;
 - .3 water meter(s) – 40 mm (1-½") thick;
 - .4 top of radiant ceiling panels – 50 mm (2") thick.
- .2 Unless otherwise noted, wrap equipment to a thickness and insulating value equal to an equivalent thickness of rigid sectional pipe insulation. Laminate insulation in place with a full coverage of adhesive and secure with wire. Apply a jacket of insulation vapour barrier material secured in place with adhesive or sealant tape.
- .3 Cover roof drain sumps with purpose made PVC fitting covers.
- .4 Lay fibreglass blanket on radiant ceiling panels after testing is complete.

3.09 Equipment Insulation Requirements – Semi-Rigid Mineral Fibre

- .1 Insulate following equipment with semi-rigid mineral fibre board insulation of thickness indicated:
 - .1 refrigeration machine water chiller(s) and suction elbow(s) – 50 mm (2") thick;
 - .2 uninsulated domestic hot water storage tank(s) – 40 mm (1-½") thick;
 - .3 shell and tube type heat exchangers – 40 mm (1-½") thick;
 - .4 chilled water or chilled glycol solution storage tank – 50 mm (2") thick;
 - .5 heating main air separator – 40 mm (1-½") thick;
 - .6 chilled water expansion tank – 40 mm (1-½") thick.
- .2 Install insulation as required to fit shape and contour of equipment. Secure insulation in place with adhesive, and with aluminum straps on 450 mm (18") centres. Apply a 6 mm (¼") thick skim coat of insulating cement, then, when insulating cement has dried, apply a 6 mm (¼") thick coat of cement trowelled smooth.
- .3 For "cold" equipment, prime insulation with suitable sealer and apply a jacket of glass thread reinforced foil and kraft paper vapour barrier jacket material laminated in place with a full coverage of adhesive.
- .4 Provide removable and replaceable insulated metal covers for equipment with removable heads to permit heads to be removed and replaced without damaging adjacent insulation work.

3.10 Equipment Insulation Requirements – Removable/Reusable Type

- .1 Provide custom designed and manufactured removable and reusable insulation covers for following:
 - .1 plate type heat exchanger(s);
 - .2 150 mm (6") dia. and larger piping strainers, backflow preventers, etc.;
- .2 Provide "wrap type" removable and reusable insulation covers for "cold" circuit balancing valves, backflow preventers, and similar items, and for steam traps and similar items requiring service in piping less than 150 mm (6") dia.

3.11 Ductwork Insulation Requirements – Mineral Fibre

- .1 Insulate following ductwork systems inside building and above ground with mineral fibre insulation of thickness indicated:
 - .1 outside air intake ductwork, casings and plenums from fresh air intakes to and including mixing plenums or sections, or, if mixing plenums or sections are not provided, to first heating coil, or if both mixing plenums or sections and heating coil sections are not provided, and fresh air is not tempered, then the fresh air ductwork system complete – minimum 40 mm (1-½") thick as required;
 - .2 mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
 - .3 supply air ductwork outward from fans, except for supply ductwork exposed in area it serves – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
 - .4 exhaust discharge ductwork for a distance of 3 m (10') downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10') distance – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
 - .5 any other ductwork, casings, plenums or sections specified or detailed on drawings to be insulated – thickness as specified.

- 2 Provide rigid board type insulation for casings, plenums, and exposed rectangular ductwork. Provide blanket type insulation for round ductwork and concealed rectangular ductwork.
- 3 Liberally apply adhesive to surfaces of exposed rectangular ducts and/or casings. Accurately and neatly press insulation into adhesive with tightly fitted butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom and side surfaces. Secure and seal joints with 75 mm (3") wide tape sealant. Additional installation requirements as follows:
 - .1 at trapeze hanger locations, install insulation between duct and hanger;
 - .2 provide drywall type metal corner beads on edges of ductwork, casings and plenums in equipment rooms, service corridors, and any other area where insulation is subject to accidental damage, and secure in place with tape sealant.
- 4 Liberally apply adhesive to surfaces of concealed rectangular or oval ductwork, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom surfaces. Secure and seal joints with 75 mm (3") tape sealant. At each trapeze type duct hanger, provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between duct and hanger.
- 5 Accurately cut sections of insulation to fit tightly and completely around exposed and concealed round or oval ductwork. Liberally apply adhesive to surfaces of duct, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Seal joints with tape sealant. At duct hanger locations install insulation between duct and hanger. At each hanger location for concealed ductwork where flexible blanket insulation is used, provide a 100 mm (4") wide full circumference strip of semi-rigid board type duct insulation between duct and hanger.
- 6 Insulation application requirements common to all types of rigid ductwork are as follows:
 - .1 at duct connection flanges, insulate flanges with neatly cut strips of rigid insulation material secured with adhesive to side surfaces of flange with a top strip to cover exposed edges of the side strips, then butt the flat surface duct insulation up tight to flange insulation, or, alternatively, increase insulation thickness to depth of flange and cover top of flanges with tape sealant;
 - .2 installation of fastener pins and washers is to be concurrent with duct insulation application;
 - .3 cut insulation fastener pins almost flush to washer and cover with neatly cut pieces of tape sealant;
 - .4 accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers;
 - .5 prior to concealment of insulation by either construction finishes or canvas jacket material, patch vapour barrier damage by means of tape sealant.

3.12 Ductwork Insulation Requirements – Flexible Elastomeric

- .1 Insulate exposed exterior ductwork (except fresh air intake ductwork) and associated plenums and/or casings outside building with minimum 40 mm (1-½") thick flexible elastomeric sheet insulation as required, applied in 2 minimum 20 mm (¾") thick layers with staggered tightly butted joints.
- .2 Install with adhesive in strict accordance with manufacturer's instructions to produce a weather-proof installation. Ensure sheet metal work joints are sealed watertight prior to applying insulation.

3.13 Ductwork Insulation Requirements – Calcium Silicate

- .1 Insulate following kitchen exhaust ductwork with minimum 40 mm (1-½") thick calcium silicate block insulation:
 - .1 kitchen exhaust ductwork from exhaust hood to masonry shaft – 2 hour rating;
- .2 Secure insulation in place with adhesive and with wire on 450 mm (18") centres. Point gaps and joints with insulating cement. Where ductwork is exposed, cover insulation with wire mesh secured to wire and with edges laced together and apply a coat of finishing cement trowelled smooth. Use drywall type metal corner bead for duct edges where finishing cement is applied.

3.14 Duct Wrap Requirements – Fire Rated Material

- .1 Provide blanket type fire rated duct wrap system material for following ductwork to produce fire rating indicated:
 - .1 kitchen exhaust ductwork from exhaust hood to masonry shaft – 2 hour rating;
- .2 Install duct wrap material in accordance with ULC design requirements and supplier's/manufacturer's instructions.
- .3 Coordinate installation of duct wrap with installation of ductwork.
- .4 Arrange and pay for duct wrap supplier to examine completed duct wrap system at site. Submit a letter from supplier to certifying duct wrap system has been properly installed.

3.15 Application of Insulating Coatings

- .1 Apply, in accordance with manufacturer's instruction, insulating coatings to following bare metal surfaces:
 - .1 paint bare metal surfaces clear of "cold" piping and/or equipment insulation for a distance of from 300 mm (12") to 600 mm (24") clear of pipe or equipment insulation, with "No Sweat-FX" anti-condensation coating;
 - .2 paint bare metal surfaces associated with mechanical systems with an operating temperature 60°C (140°F) with "ThermaLite" insulating coating.
- .2 Apply coatings with a brush. Remove any splatter or excess coating from adjacent surfaces.

3.16 Insulation Finish Requirements

- .1 Unless otherwise shown and/or specified, jacket exposed mineral fibre insulation, and calcium silicate duct insulation work inside building with canvas secured in place with a full covering coat of lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent uninsulated surfaces.
- .2 Jacket exposed pipe insulation work inside building with white sheet PVC and fitting covers. Install sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal joints to produce a neat water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions.
- .3 Apply 2 heavy coats of "PITTCOTE 404" coating with 24 hr. between coats to foamed glass insulation exposed above grade.
- .4 Apply 2 coats (with 24 hr. between coats) of specified coating to flexible elastomeric insulation outside building.

End of Section

1 General

1.01 Application

- .1 This Section specifies commissioning requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. When requirements of this Section contradict requirements of Division 00 or Division 01, conditions of Division 00 or Division 01 to take precedence.

1.02 Reference

- .1 Refer to commissioning requirements specified in Division 01.

1.03 Commissioning Agent Involvement Versus Warranty Obligations

- .1 Involvement of Commissioning Agent performing duties as described in this Section is not in any way to void or alter any Contractual warranty obligations.

1.04 Submittals

- .1 Submit to Commissioning Agent, at same time as submittal to Consultant, one copy of each shop drawing or product data sheet associated with equipment or systems to be commissioned.
- .2 Submit for review, a Commissioning Plan with schedule, commissioning procedures for commissioning events, and a copy of Commissioning Agent's commissioning data sheets for equipment/systems to be commissioned.
- .3 Submit a list of commissioning instruments and for each instrument, indicate purpose of instrument and include a recent calibration certificate.
- .4 Submit equipment and system manufacturer's start-up and test report sheets for review a minimum of 1 month prior to equipment and system start-up procedures.
- .5 After start-up and successful pre-functional performance testing and submittal of completed forms, submit, for each system or subsystem, a letter confirming pre-functional performance testing has been successfully completed and system or subsystem is ready for functional performance testing and commissioning process to commence.

1.05 Definitions

- .1 Commissioning: process of demonstrating to Owner and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents, all as further described below.
- .2 Commissioning Agent: commissioning authority who will supervise commissioning process, and who will recommend final acceptance of commissioned mechanical work.
- .3 Start-Up and Adjusting: process of equipment manufacturer's/supplier's technical personnel, with Contractor, starting and operating equipment and systems, making any required adjustments, documenting process, and submitting manufacturer's/supplier's start-up reports to confirm equipment has been properly installed and is operational as intended.
- .4 Pre-Functional Performance Testing: testing, adjusting and operating of components, equipment, systems and/or subsystems, by Contractor, after start-up but before functional performance testing, to confirm components, equipment, systems and/or subsystems operate in accordance with requirements of Contract Documents, including modes and sequences of control and monitoring, interlocks, and responses to emergency conditions, and including submittal of pre-functional performance testing documentation sheets.
- .5 Functional Performance Testing: a repeat of successful pre-functional performance testing by Contractor, in presence of Commissioning Agent and Consultant with completed Commissioning Agent's commissioning documentation sheets to document, validate and verify equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.

- .6 Commissioning Documentation Sheets: prepared sheets for pre-functional performance testing and for functional performance testing supplied by Commissioning Agent for each piece of equipment/system to be commissioned, each sheet or set of sheets complete with Project name and number, date of commissioning, equipment/system involved, equipment/system name and model number, equipment tag in accordance with drawings, and, for each commissioning procedure listed, a column giving expected data in accordance with Contract Documents, a column to fill in observed data during commissioning, and space for signatures of Contractor and Commissioning Agent.
- .7 Systems Operating Manual: a manual prepared by Commissioning Agent to present an overview of building mechanical systems and equipment to be used by building maintenance personnel to assist them in daily operation of systems.
- .8 Validate: to confirm by examination and witnessing tests correctness of equipment and system operation.

1.06 Quality Assurance

- .1 Commissioning work is to be in accordance with requirements of following:
 - .1 CSA Z320, Building Commissioning Standard and Check Sheets;
 - .2 ASHRAE Guideline 0, The Commissioning Process;
 - .3 ASHRAE Guideline 1.1, The HVAC Commissioning Process;
 - .4 ASHRAE Guideline 1.2, The Commissioning Process for Existing HVAC&R Systems;
 - .5 ASHRAE Guideline 1.5, Commissioning Smoke Control Systems;
 - .6 Owner designated Commissioning Agent.

1.07 Commissioning Objectives

- .1 Objectives of commissioning process:
 - .1 to support quality management by means of monitoring and checking installation;
 - .2 to verify equipment/system performance by means of commissioning of completed installation;
 - .3 to move completed equipment/systems from "static completion" state to "dynamic" operating state so as to transfer a complete and properly operating installation from Contractor to Owner.

1.08 Testing Equipment

- .1 Supply instruments and test equipment required to conduct start-up, testing and commissioning procedures.

2 Products – Not Used

3 Execution

3.01 Commissioning

- .1 Commission work in accordance with requirements of this Section and as required by Commissioning Agent.
- .2 Prerequisites to successful completion of commissioning:
 - .1 submittal of signed start-up and test reports;
 - .2 completion of system testing, adjusting and balancing (TAB), and acceptance of TAB reports;

- .3 permanent electrical and control connections of equipment;
- .4 successful completion and documentation of pre-functional performance testing;
- .5 submittal of letters to Consultant certifying systems and subsystems have been started, tested, adjusted, successfully pre-functional performance tested, are ready for functional performance testing, and are in accordance with requirements of Contract Documents.

3.02 Phasing of Commissioning

- .1 If Project will be constructed in phases, phase commissioning accordingly to suit progress and phases of Work.

3.03 Deficiencies Listed During Commissioning

- .1 Correct deficiencies listed by Consultant and Commissioning Agent during commissioning process within 15 calendar days of notification unless agreed otherwise with Consultant, and when deficiencies have been corrected, notify Consultant and Commissioning Agent immediately.

3.04 Systems to be Commissioned

- .1 Mechanical systems to be commissioned include, but are not to be limited to, systems described below. Specific commissioning procedures are to be as directed by Commissioning Agent.
- .2 Commissioning of drainage systems includes:
 - .1 commissioning of drainage pumps and controls by means of tests recommended by manufacturer to confirm proper operation and performance;
 - .2 commissioning of equipment such as interceptors and backflow preventers.
- .3 Commissioning of fire protection systems will be considered complete upon preparation and submittal by Contractor of completion certificates required by applicable NFPA Standards, demonstration of proper system operation to local Fire Chief and any other authorities, including Owner's insurance underwriter as required, and coordination and cooperation with fire alarm system commissioning procedures, in particular smoke control systems and other such fan system control sequences.
- .4 Commissioning of water systems (all piping extended from Municipal main) includes:
 - .1 commissioning of pumps and controls;
 - .2 commissioning of water heaters;
 - .3 commissioning of piping specialties such as backflow preventers, mixing valves, and similar components;
 - .4 commissioning of trap seal primer units, including adjustment of water flows and confirmation of water flow at each connected trap;
 - .5 commissioning of plumbing fixtures.
- .5 Commissioning of swimming pool systems includes pool piping and fittings, pumping equipment and controls, filtering equipment, and chemical treatment equipment, as well as any specialized equipment for pool area such as dehumidifiers.
- .6 Commissioning of laboratory systems includes piping, fittings including bench work fittings, and associated equipment including special ventilation systems.
- .7 Commissioning of medical gas systems is not part of mechanical commissioning work and will be done as part of work specified in the Section 22 63 00 – Gas Systems for Laboratory and Healthcare Facilities.
- .8 Commissioning of compressed air system includes "head end" compressor equipment, pressure reducing equipment, and outlets.

- .9 Commissioning of natural gas system includes pressure regulating equipment. Perform commissioning in accordance with requirements of CAN/CSA B149.1, and any supplemental requirements of governing authorities.
- .10 Commissioning of propane gas system includes pressure regulating equipment. Perform commissioning in accordance with requirements of CAN/CSA B149.2, and any supplemental requirements of governing authorities.
- .11 Perform commissioning of fuel oil system in accordance with requirements of CAN/CSA B139.
- .12 Commissioning of heating systems includes piping, piping specialties, equipment, and control, as well as checking and validating temperature and flow documentation contained in TAB reports. If TAB is not done during heating season, a follow-up site visit during heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
- .13 Commissioning of cooling systems includes piping, piping specialties, equipment, and control, as well as checking and validating temperature and flow documentation contained in TAB reports. If TAB is not done during cooling season, a follow-up site visit during cooling season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
- .14 Commissioning of HVAC chemical treatment systems includes feed and monitoring equipment, and testing of system fluids to confirm proper concentration of chemical.
- .15 Commissioning of air handling systems includes equipment, ductwork, ductwork specialties, controls, interlocks, and checking and validating air capacities and flows in accordance with TAB reports.
- .16 Control work commissioning includes confirmation of proper operation of individual control components, and overall operation of controls in conjunction with operation of connected building systems, including heating season/cooling season testing requirements specified above.
- .17 Commissioning of BAS includes confirmation of proper operation of components, input/output points, hardware and software, and demonstration of system performing required procedures.
- .18 Commissioning of special usage room controls includes confirmation of proper operation of individual components, and proper operation of overall control system, all in accordance with governing Codes and Standards.
- .19 Commissioning of noise and vibration control equipment includes noise and vibration measurements to confirm proper operation of equipment.

3.05 Commissioning Process

- .1 Perform commissioning process in stages and include, but not be limited to, following:
 - .1 Stage 1: Commissioning of equipment/systems as listed in this Section, which is a prerequisite to an application for Substantial Performance of the Work and includes supervising and validating results of functional performance testing, and submittal of reviewed Systems Operating Manual.
 - .2 Stage 2: Commissioning work performed 12 months after issue of a Certificate of Substantial Performance and which includes supervision of Contractor's "fine tuning" of equipment/systems through seasonal occupancy, and any other such work to achieve optimal comfort and performance conditions.
 - .3 Stage 3: Successful completion of satisfactory equipment/system operation during 1st month after issue of a Certificate of Total Performance of the Work.
 - .4 Stage 4: Successful completion of satisfactory equipment/system operation during 3rd month after issue of a Certificate of Total Performance of the Work.
 - .5 Stage 5: Successful seasonal commissioning of building.

3.06 Responsibilities of Contractor

- .1 During construction phase, Contractor is to:

- .1 prepare and submit an installation schedule which includes a time schedule for each activity with lead and lag time allowed and indicated, shop drawing and working detail drawing submissions, and major equipment factory testing and delivery dates;
 - .2 prepare and submit a commissioning schedule which is to include a time schedule coordinated with installation schedule referred to above and Commissioning Agent, and allowances for additional time for re-tests as may be required, and update schedule on a monthly basis as required;
 - .3 when requested by Commissioning Agent, arrange site commissioning meetings with Owner, Consultant, and applicable subcontractors present, to be chaired by Commissioning Agent who will also prepare and distribute meeting minutes;
 - .4 promptly correct reported deficient work, and report when corrective work is complete;
 - .5 where required by Codes and/or Specification, retain equipment manufacturers/suppliers or independent 3rd parties to certify correct installation of equipment/systems;
 - .6 under supervision of equipment manufacturers/suppliers, start-up and adjust equipment to design requirements, and submit start-up sheets which include equipment data such as manufacturer and model number, serial number where applicable, and performance parameters, all signed by equipment manufacturer/supplier and Contractor;
 - .7 complete Commissioning Agent's commissioning data sheets for multiple items of smaller equipment such as air terminal boxes, fan coil units, backflow preventers, etc., submit sheets to Commissioning Agent, accompany Commissioning Agent for an on-site check of 30% of data sheet information for each type of equipment, and perform any corrective action required as a result of site checks;
 - .8 perform system testing, adjusting and balancing and, when complete, issue a copy of final report to Commissioning Agent for review and a site check of results, and perform any corrective work required as a result of site checks by Commissioning Agent;
 - .9 in accordance with updated commissioning schedule and actual progress at site, certify in writing to Consultant and Commissioning Agent that equipment and/or systems are complete, have been checked, started and adjusted, successfully pre-functional performance tested and documented, and are ready for functional performance testing and commissioning procedures, giving Consultant and Commissioning Agent a minimum of 5 working days' notice;
 - .10 perform system and subsystem functional performance testing under supervision of Commissioning Agent, and submit to Consultant and Commissioning Agent, completed and signed functional performance testing and commissioning data sheets (issued by Commissioning Agent) and also signed by Commissioning Agent.
- .2 During post construction phase, Contractor is to:
- .1 optimize system operation in accordance with building occupant's needs and comments using System Operation Manual prepared by Commissioning Agent as reference;
 - .2 complete commissioning procedures, activities, and performance verification procedures that were delayed or not concluded during construction phase;
 - .3 accompanied by Commissioning Agent, complete system checks and "fine tuning" with signed documentation as follows:
 - .1 once during 1st month of building operation;
 - .2 once during 3rd month of building operation;
 - .3 once between 4th and 10th months in a season opposite to 1st and 3rd month visits.
 - .4 correct deficiencies revealed by system checks described above, and, where required, involve equipment manufacturers/suppliers during corrective actions, and report completion of corrective work;

- .5 3 months after Substantial Completion conduct a question and answer session(s) at building with Owner's operating and maintenance personnel, with duration of session(s) dictated by number of questions and concerns that have to be addressed.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for all products specified in Part 2 of this Section except for pipe, fittings, and chlorine solution.

1.02 Closeout Submittals

- .1 Submit laboratory water purity test results indicating chlorine residual prior to application for Substantial Performance of the Work.
- .2 Prior Substantial Performance of the Work, submit a minimum of 3 identified keys for key operated hydrants.
- .3 Submit signed test results and inspection and test log cards for each backflow preventer as specified in Part 3 of this Section.
- .4 Submit anchor drawing(s) to detail fabrication and installation of water piping anchors. Drawing(s) are to be prepared and stamped by a professional structural engineer registered and licensed in jurisdiction of the work.
- .5 As specified in Part 3 of this Section, submit a letter from anchor design engineer stating anchor installation has been examined at site and anchors are properly fabricated and installed.

1.03 Quality Assurance

- .1 Domestic water piping and valves are to comply with following codes, regulations and standards (as applicable):
 - .1 applicable local codes and regulations;
 - .2 CAN/CSA B125.1, Plumbing Supply Fittings;
 - .3 CAN/CSA B125.3, Plumbing Fittings;
 - .4 CAN/CSA B137 Series, Thermoplastic Pressure Piping Compendium;
 - .5 NSF/ANSI 14, Plastics Piping System Components and Related Materials;
 - .6 NSF/ANSI 61, Drinking Water System Components – Health Effects;
 - .7 NSF/ANSI 372, Drinking Water System Components – Lead Content.

2 Products

2.01 Pipe, Fittings, and Joints

- .1 PVC
 - .1 ULC listed, rigid, Class 150, DR18, 1035 kPa (150 psi) pressure rated bell and spigot pattern PVC pipe to CAN/CSA B137.3, and CSA certified fittings to CAN/CSA B137.2, and AWWA C900, complete with gasket joints, and Ford "Uni-Flange" or equal restraint collars as per Part 3 of this Section.
- .2 Soft Copper
 - .1 Type "K" soft copper to ASTM B88, supplied in a continuous coil with no joints if possible, and complete with, if joints are required, compression type flared joint couplings.
- .3 Stainless Steel

- .1 Schedule 10S type 304 stainless steel, ASTM A312, factory or site roll grooved, complete with Victaulic or equal type 304 stainless steel roll grooved end fittings and, unless otherwise specified, Victaulic Style 807, 877 or 889 couplings color coland coupling gaskets equal to Victaulic Grade P fluoroelastomer.
- .4 Copper - Solder Joint
 - .1 Type "L" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints using The Canada Metal Co. Ltd. "SILVABRITE 100" or equal lead-free solder for cold water pipe, and 95% tin / 5% Antimony or "SILVABRITE 100" solder for other services.
- .5 Copper - Pressure Coupled Joint
 - .1 Type "L" hard drawn seamless copper to ASTM B88 with Viega "ProPress with Smart Connect feature" copper fittings with EDPM seals, and pressure type crimped joints made by use of manufacturer recommended tool.
- .6 Copper - Grooved
 - .1 Type "L" hard drawn seamless copper to ASTM B88 with Victaulic QuickVic Style 607 non-reducing, bolted connection type suitable and approved for application intended, 2" - 8" for copper tubing consisting of ductile iron cast housings, complete with a Grade P fluoroelastomer gasket of a pressure-responsive design, with plated nuts and bolts to secure unit together.
- .7 Semi-Rigid Polyethylene Tubing
 - .1 Versa Fittings and Mfg. Inc. 12 mm (½") dia., high density, semi-rigid polyethylene tubing, 1380 kPa (200 psi) rated.
- .8 CPVC
 - .1 Ipex "Aquarise" CPVC pipe and fittings to CAN/CSA B137.6, 25/50 flame spread and smoke developed rated in accordance with CAN/ULC S102.2, and complete with primer/solvent weld joints.
 - .2 Option: Fittings equal to Victaulic PGS-300 grooved piping system for schedule 40 and schedule 80 CPVC pipe per ASTM F441, 23447 minimum cell classification per ASTM D1784. Sizes 50-300 mm (2" - 12") consisting of ductile iron cast housings, complete with a grade "EHP" EPDM gasket of a pressure-responsive design, with plated nuts and bolts to secure unit together (Victaulic Style 357).
- .9 Flexible Polyethylene
 - .1 Flexible polyethylene pipe to CAN/CSA B137.1, 690 kPa (100 psi) rated, complete with insertion type fittings secured with Series 300 stainless steel gear type clamps.
- .10 Cross-Linked Polyethylene (PEX) Tubing
 - .1 Non-barrier type PEX piping in accordance with CAN/CSA B137.5, ASTM F876 and tested for compliance by an independent third-party agency, 25/50 flame spread/smoke developed rated when tested to CAN/ULC S102.2 and complete with brass inserts and crimp-ring or cold-expansion joint fittings and couplings.

2.02 Shut-Off Valves

- .1 Ball Valves
 - .1 Class 600, 4140 kPa (600 psi) WOG rated, lead-free, full port ball type valves, each complete with a forged brass body with solder ends, forged brass cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, and a removable lever handle. Valves in insulated piping are to be complete with stem extensions.
 - .2 Acceptable products are:
 - .1 Toyo Valve Co. Fig. 5049A-LF;

- .2 Milwaukee Valve Co. #UPBA485B;
- .3 Kitz Corporation Code 859;
- .4 Apollo Valves #77LF-200;
- .5 Watts Industries (Canada) Inc. #LFFBVS-3C.

.2 Butterfly Valves - Flanged Joint

.1 Non-corrosive, minimum 1200 kPa (175 psi) cold water pressure rated, resilient seated butterfly valves, each complete with a coated cast ductile iron lug type body, stainless steel shaft, bronze disc, and EPDM seat, and each suitable for domestic water bubble-tight dead end service with valve in position and either side of connecting piping removed. Butterfly valves to and including 100 mm (4") dia. are to be equipped with lever handles. Butterfly valves larger than 100 mm (4") dia. are to be equipped with worm gear operators.

.2 Acceptable products are:

- .1 DeZurik #632L Series;
- .2 Kitz Corporation Code #6122EL/EG;
- .3 Toyo Valve Co. #918BESL/EG;
- .4 Bray Valve and Controls Canada Series 31;
- .5 Apollo Valves #141 Series;
- .6 Watts Industries (Canada) Inc. #BF-03.

.3 Butterfly Valves – Grooved End

.1 Equal to Victaulic Series 608N, for copper pipe rated to 300 psi and be both bi-directional and dead-end service capable to full rated pressure. Seat material shall be EPDM UL Classified in accordance with ANSI/NSF 61 for ambient +86°F and hot +180°F potable water service and ANSI/NSF 372.

.2 Victaulic Series 461, for stainless steel pipe rated to 300 psi and be both bi-directional and dead-end service capable to full rated pressure. Seat material shall be EPDM UL Classified in accordance with ANSI/NSF 61 for ambient +86°F and hot +180°F potable water service and ANSI/NSF 372.

2.03 Check Valves

.1 Horizontal

.1 Lead-free, Class 125, bronze, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with solder ends.

.2 Acceptable products are:

- .1 Toyo Valve Co. Fig. 237A-LF;
- .2 Milwaukee Valve Co. #UP1509;
- .3 Kitz Corporation Code 823;
- .4 Apollo Valves #61LF Series.

.2 Vertical

.1 Equal to Kitz Corp. Code 826, lead-free, 1725 kPa (250 psi) WOG rated vertical lift check valve with soldering ends.

2.04 Drain Valves

- .1 Minimum 2070 kPa (300 psi) water rated, 20 mm ($\frac{3}{4}$ " dia., straight pattern full port bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm ($\frac{3}{4}$ " dia. garden hose, and a cap and chain.
- .2 Acceptable products are:
 - .1 Toyo Valve Co. Fig. 5046;
 - .2 Dahl Brothers Canada Ltd. Fig. No. 50. 430;
 - .3 Kitz Corporation Code 58CC;
 - .4 Apollo Valves #78-104-01;
 - .5 Watts Industries (Canada) Inc. #B6000.

2.05 Domestic Hot Water Piping Balancing Valves

- .1 Equal to Victaulic Series 76X Low Lead Balancing Valve, lead-free and compliant with NSF-61 and NSF-372 for use in potable water applications, automatic flow limiting balancing valve (+/-5% over rated operating pressure range), complete with removable flow cartridge.
- .2 Equal to Victaulic TA Series 78BL, solder or flange end type as required, ball valve style, lead-free and compliant with NSF-61 and NSF-372 for use in potable water applications, circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.

2.06 Partition Stops

- .1 Equal to Dahl Brothers Canada Ltd. Fig. E2300 Series or equal lead-free partition stops with EDPM packing, slotted spindles, extension tubes, stainless steel access plates, and 3 identified keys.

2.07 Pressure Reducing Valves

- .1 For piping less than or equal to 50 mm (2") diameter, lead-free, non-corrosive, non-ferrous direct spring acting pressure reducing valves to CAN/CSA B356, each factory set at 345 kPa (50 psi) unless otherwise specified or required, each field adjustable from 175 kPa (25 psi) to 520 kPa (75 psi) and each complete with an integral inlet strainer. Acceptable products are:
 - .1 Apollo Valves #36HLF Series;
 - .2 Zurn/Wilkins #600XL Series;
 - .3 Watts Industries (Canada) Inc. #LF25AUB-Z3 Series;
 - .4 Cash-Acme EB-25 Series;
 - .5 Bermad Series 935-H
- .2 For piping greater than or equal to 65 mm (2- $\frac{1}{2}$ " diameter, lead-free, non-corrosive pilot operated pressure reducing valve to CAN/CSA B356, factory set at required pressure, field adjustable, and complete with a bronze body and trim, screwed or flanged connections, and brass body pilot valve with stainless steel seat. Acceptable products are:
 - .1 Singer Valve #106 PR;
 - .2 Zurn/Wilkins #ZW209;
 - .3 Watts Industries (Canada) Inc. #LFN223 Series;

- .4 Bermad Series 972.

2.08 Domestic Hot Water Thermostatic Mixing Valves

- .1 Lawler Manufacturing Co. Inc. 800 Series "High-Low Thermostatic Mixer" factory assembled rough bronze thermostatic mixing valve assembly complete with rotatable union end inlet piping with check stops and stainless steel strainer screens, union outlet piping with thermometer connection, all sized as shown, and following:
 - .1 mixing valve with liquid motor, stainless steel piston and liner, tamper-resistant control adjustment, and 3-way protection against runaway temperatures, thermal shock, and scalding;
 - .2 dial type thermometer conforming to requirement specified in Section 20 05 00 – Common Work Results for Mechanical;
 - .3 ball type outlet shut-off valve conforming to valve requirements specified in this section;
 - .4 surface wall mounting enamelled steel cabinet with hinged door, key lock, and permanent identification;
 - .5 recessed wall mounting type 304 stainless steel cabinet with a #4 finish, hinged door, key lock, and permanent identification.
- .2 Acceptable manufacturers are:
 - .1 Lawler Manufacturing Co. Inc.;
 - .2 Leonard Valve Co.;
 - .3 Symmons Industries Inc.

2.09 Chlorine

- .1 Sodium hypochlorite to AWWA B300.

2.10 Water Meter

- .1 Equal to Neptune Technology Group (Canada) Ltd. "Neptune T-10" tamper-proof, in line serviceable meter in accordance with requirements of AWWA C701 and NSF/ANSI 61, suitable for connection of a remote automatic reading and billing unit and complete with a cast bronze main case, a roll sealed register, and a positive displacement rotating disc measuring chamber.
- .2 Equal to Neptune Technology Group (Canada) Ltd. "Neptune High Performance Turbine" tamper-proof, in-line serviceable meter in accordance with requirements of AWWA C701 and NSF/ANSI 61, suitable for connection of a remote automatic reading and billing unit and complete with a cast bronze main case, a roll-sealed magnetic drive register, and a turbine measuring element.
- .3 Equip meter with a Neptune Technology Group (Canada) Ltd. or equal "ARB-V" surface wall mounting automatic meter reading and billing unit with encoder register, polycarbonate housing, roll-sealed copper shell, and ABS plastic receptacle.
- .4 Meter is also to be complete with Neptune Technology (Canada) Ltd. or equal "Tricon" hardware for interface connection to building automation system for water flow and consumption monitoring.

2.11 Interior Hose Bibbs

- .1 Flush-Concealed
 - .1 Recessed, 92 mm (3-5/8") deep, recessed, encased wall hydrant with lockable bronze or stainless steel box with hinged cover identified "WATER", bronze interior parts, a screwdriver operated stop in the supply, key operated control valve, 20 mm (3/4") dia. hose connection, and a vacuum breaker.
 - .2 Acceptable products are:

- .1 Watts Industries (Canada) Inc. #HY-330.
 - .2 Jay R. Smith #5509QT-CL-SAP;
 - .3 Zurn #Z1350;
 - .4 Mifab #MHY-55;
- .2 Semi-Recessed - Finished Areas
- .1 Anti-siphon type, 100 mm (4") deep hose bibb with stainless steel face with operating key, bronze interior parts, 20 mm (¾") dia. solder inlet, 20 mm (¾") dia. hose connection, and integral vacuum breaker.
 - .2 Acceptable products are:
 - .1 Watts Industries (Canada) Inc. #HY-430.
 - .2 Jay R. Smith #5619-SAP-98;
 - .3 Zurn #Z1333 "ECOLOTRON";
 - .4 Mifab #MHY-30;
- .3 Surface – Exposed – Cold Water – Unfinished Areas
- .1 Brass or bronze hose bibb with hose end vacuum breaker.
 - .2 Acceptable products are:
 - .1 Watts Industries (Canada) Inc. #SC8-1;
 - .2 Jay R. Smith #5609QT-SAP.
 - .3 Zurn/Wilkins # Z1341 with hose end vacuum breaker;
 - .4 Chicago Faucets #293-E27CP;
- .4 Exposed – Unfinished Areas – Hot and Cold Water
- .1 Mixing faucet for surface mounting.
 - .2 Acceptable products are:
 - .1 Watts Industries (Canada) Inc. #HY-300-2-VB.
 - .2 Jay R. Smith #5560QT-LB-SAP;
 - .3 Zurn #Z841L1-RC;
 - .4 Delta Commercial #28T8083;

2.12 Exterior Non-Freeze Wall Hydrants

- .1 Flush-Concealed
 - .1 Recessed, encased, self-draining hydrants, each complete with a copper casing, operating rod assembly to suit wall thickness, polished nickel bronze box with hinged locking cover, 20 mm (¾") dia. threaded hose connection outlet, vacuum breaker, and a loose tee handle operating key.
 - .2 Acceptable products are:

.1 Watts Industries (Canada) Inc. #HY-725.

.2 Jay R. Smith #5519-98;

.3 Zurn #Z1320;

.4 Mifab #MHY-26;

.2 Semi-Recessed

.1 Self-draining hydrants, each complete with a copper casing, operating rod assembly to suit the wall thickness, 20 mm ($\frac{3}{4}$ " dia. threaded hose connection outlet, vacuum breaker, and a loose tee handle operating key.

.2 Acceptable products are:

.1 Watts Industries (Canada) Inc. #HY-420.

.2 Jay R. Smith #5619-98;

.3 Zurn #Z1321;

.4 Mifab #MHY-16;

2.13 Exterior Non-Freeze Ground Hydrants

.1 Flush

.1 Flush with grade mounting, encased head, self-draining bronze hydrants, each complete with a casing and operating rod assembly to suit the depth of piping bury, valve housing with drain port, grade box with hinged lockable cover and drain port, 20 mm ($\frac{3}{4}$ " dia. threaded hose connection, and a loose tee handle operating key.

.2 Acceptable products are:

.1 Watts Industries (Canada) Inc. #HY-500.

.2 Jay R. Smith #5810-N-NV;

.3 Zurn #Z1360;

.4 Mifab #MHY-60;

.2 Exposed

.1 Self-draining exposed head bronze post hydrants, each complete with a casing and operating rod assembly to suit the height of hose outlet above grade and the depth of piping bury, valve housing with drain port, 20 mm ($\frac{3}{4}$ " dia. threaded hose connection assembly with vacuum breaker and gravel guard, and a loose tee handle operating key.

.2 Acceptable products are:

.1 Watts Industries (Canada) Inc. #HY-600.

.2 Jay R. Smith #5910-NV-H;

.3 Zurn #Z1385;

.4 Mifab #MHY-65;

2.14 Non-Freeze Roof Hydrant

- .1 Woodford Mfg. Model RHY2-MS non-freeze roof hydrant with 25 mm (1") diameter inlet connection, 20 mm (3/4") diameter hose end outlet with dual check backflow preventer, a 3.2 mm (1/8") diameter inlet connection drain hole to automatically drain hydrant when shut-off, a mounting system with cast iron support and under deck flange, and required mounting hardware and accessories.

2.15 Floor Drain Trap Seal Primers

- .1 Primer Valve Type
 - .1 Precision Plumbing Products Inc. Model P2-500 trap primer valve, constructed of brass, adjustable to high or low water pressures and complete with "O" ring seals, 12 mm (1/2") threaded inlet and outlet connections, and, for priming two traps from the same primer, a DU-2 dual outlet distribution unit.
- .2 Primer Valve Type with Manifold
 - .1 Precision Plumbing Products Inc. Model P1-500 trap primer valve constructed as specified above for the Model P2-500 primer valve, complete with a Model DU-3 or DU-4, 3 or 4 outlet distribution unit for priming 3 or 4 traps, and at Model "YS-8" supply tube with combinations of Model DU-3 and DU-4 distribution units for priming from 5 to 6 traps.
- .3 Electronic Type
 - .1 Precision Plumbing Products #PT Series surface wall mounting, CSA certified, 115 volt, 1-phase, 60 Hz., electronic, automatic trap priming manifolds, each sized to suit the number of drain traps or interceptors serviced, and each complete with:
 - .1 galvanized steel cabinet with door;
 - .2 20 mm (3/4") dia. NPT copper pipe inlet with shut-off valve and water hammer arrestor;
 - .3 solenoid valve, an atmospheric vacuum breaker, and a discharge manifold with 12 mm (1/2") dia. compression type copper tube connections on 40 mm (1-1/2") centres with quantity to suit the number of items to be primed;
 - .4 control panel with circuit breaker, 5 ampere fuse, 24 hour timer, and manual override toggle switch.

2.16 Shock Absorbers

- .1 Type 304 stainless steel piping shock absorbers, each complete with a nesting type bellows and a casing of sufficient displacement volume to dissipate kinetic energy generated in piping system, and each sized to suit connecting potable water pipe and equipment it is provided for.
- .2 Acceptable products are:
 - .1 Watts Industries (Canada) Inc. "SG" Series.
 - .2 Jay R. Smith 5000 Series "HYDROTROL";
 - .3 Zurn #Z1700 "SHOKTROL";
 - .4 Mifab "HAMMERGUARD" WHB Series;

2.17 Water Hammer Arrestors

- .1 Piston type, sealed, all stainless steel construction, pressurized water hammer arrestors suitable for either vertical or horizontal installation, each complete with a pressurized compression chamber, welded nesting-type expansion bellows surrounded by non-toxic mineral oil, and a male treaded nipple connection.

- .2 Acceptable products are:
 - .1 Jay R. Smith 5000 Series;
 - .2 Precision Plumbing Products "SS" Series.
- .3 Piston type, sealed, pressurized water hammer arrestors suitable for either horizontal or vertical installation, each complete with a hard drawn copper body, "O"-ring piston seals, an air charge, and an inlet opening equal to diameter of pipe in which arrestor is required.
- .4 Acceptable products are:
 - .1 Watts Industries (Canada) Inc.;
 - .2 Zurn #Z1705;
 - .3 Precision Plumbing Products Inc. #SC;
 - .4 Mifab MWH Series.

2.18 BackFlow Preventers

- .1 Double Check Valve Assembly
 - .1 Minimum 1205 kPa (175 psi) rated lead-free dual check valve assembly backflow preventer to CAN/CSA B64 (including supplements), complete with tight-closing resilient seated shut-off valves, test cocks and strainer.
 - .2 Acceptable manufacturers are:
 - .1 Watts Industries Canada;
 - .2 Zurn/Wilkins;
 - .3 Apollo Valves (Conbraco Industries).
- .2 Reduced Pressure Zone Assembly
 - .1 Lead-free reduced pressure zone assembly backflow preventer in accordance with CAN/CSA B64 (including supplements), each of bronze or epoxy coated cast iron bronze fitted construction depending on size, and complete with inlet strainer, inlet and outlet shut-off valves, an intermediate relief valve, ball valve type test cocks, and a proper air gap fitting.
 - .2 Acceptable products are:
 - .1 Watts Industries #LF009QT-S for 12 mm (½") size, #LF909QT-S for 20 mm to 50 mm (¾" to 2") size, and #LF909-NRS-S for 65 mm (2-½") and larger size;
 - .2 Zurn/Wilkins 975XL2 and 375 Series;
 - .3 "Apollo" Valves manufactured by Conbraco Industries Inc. Series 4ALF;
 - .4 Danfoss Flomatic Corp. Series RPZ.

2.19 Piping Expansion Compensators and Guides

- .1 Pressurized type, selected to withstand system pressure and to suit calculated movement from -5°C (23°F) to maximum operating temperature plus 25% safety factor, complete with stainless steel bellows and shroud, copper tube sweat type female ends, anti-torque device, and proper and suitable alignment guides for both sides of each compensator.

- .2 Acceptable products are:
 - .1 Senior Flexonics Series HB;
 - .2 Hyspan Precision Products Series 8500.

2.20 Pipe Anchors

- .1 Welded structural black steel anchors of a design, size, and type to securely anchor pipe at point shown. Each anchor is to withstand 150% axial thrust, and is to be designed and detailed by a professional structural engineer registered and licensed in jurisdiction of the work. Submit anchor design and fabrication shop drawings, stamped by design engineer.

2.21 Lavatory Supply Fitting Tempering Valves

- .1 Equal to Powers "HydroGuard" Series 490, model LM490 12 mm ($\frac{1}{2}$ " dia. or model LM491 20 mm ($\frac{3}{4}$ " dia. as required, each CSA B125 certified, forged brass, tamper-proof thermostatic mixing valves, adjustable for water supply between 29°C and 49°C (85°F and 120°F), sized to suit number of lavatories in grouping, and complete with a stop and check valve and a lockable handle.
- .2 Each mixing valve is to be complete with a stainless steel flush wall mounting cabinet with vandal-proof hinged door.

2.22 Air Vents

- .1 Equal to ITT Hoffman Specialty No. 78 cast brass, 1035 kPa (150 psi) rated, 20 mm ($\frac{3}{4}$ " straight water main vent valves, each tapped at the top for a 3.2 mm ($\frac{1}{8}$ ") safety drain connection.

2.23 Domestic Water Thermal Expansion Tank

- .1 Pre-charged domestic water thermal expansion tank in accordance with Section VIII of the ASME Boiler and Pressure Code, carbon steel outer shell construction and complete with fixed butyl rubber bladder to prevent water from contacting shell interior, top NPT stainless steel system connection, 7.6 mm to 813 mm (0.301" to 32") charging valve connection and prime painted exterior.
- .2 Acceptable products are:
 - .1 Watts Industries (Canada) Inc. Series DETA;
 - .2 Zurn/Wilkins Model WTTA.

3 Execution

3.01 Demolition

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Underground Municipal Service Connection

- .1 Make required arrangements with Municipality for installation of domestic water service piping from Municipal main to property line.
- .2 Pay charges levied by Municipality for service connection work.
- .3 Municipal charges for underground street service connection work will be paid out of a prime cost allowance. Submit original copies of invoices issued by Municipality for street service connection work.

3.03 Piping Installation Requirements

- .1 Provide required domestic water piping.

- .2 Piping, unless otherwise specified, is as follows:
 - .1 for underground piping 100 mm (4") dia. and larger outside and/or inside the building – rigid PVC;
 - .2 for underground piping less than 100 mm (4") dia. inside building – Type "K" soft copper;
 - .3 for pipe 100 mm (4") dia. and larger inside building and above ground – Schedule 10 stainless steel;
 - .4 for 12 mm (½") dia. trap seal primer tubing located underground or in concrete or masonry construction – semi-rigid polyethylene;
 - .5 for pipe inside building and aboveground in sizes to 100 mm (4") dia., except in vertical shafts and through fire barriers – rigid CPVC;
 - .6 for branch hot and cold piping aboveground from mains and risers to fixtures, fittings, and equipment where fire rated construction is not penetrated – at your option, PEX tubing installed and joined in strict accordance with manufacturer's instructions;
 - .7 for underground piping outside building to fixtures/outlets at grade level – flexible polyethylene, snaked in the trench and in a continuous length wherever possible;
 - .8 for pipe inside building and aboveground in sizes to 100 mm (4") dia. – Type "L" hard copper with solder joints.
 - .1 Option: Type "L" hard copper with pressure coupled mechanical joints.
 - .2 Option: Type "L" hard copper with grooved end mechanical joints.
 - .1 Grooved pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. All couplings will meet Victaulic standards for visual inspection sizes 2" to 8". The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Install in accordance with manufacturer's latest recommendations. A Victaulic factory trained representative shall periodically visit the job site and review the installation for best practices. The installing Contractor shall correct any identified deficiencies. Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Victaulic prior to the completion of the project.
- .3 Brace and secure underground water service pipe at bends, tees and similar fittings with restraint devices, and provide concrete thrust blocks in accordance with Municipal standards and details. Regardless of what is specified elsewhere in this Specification regarding provisions of concrete, provide thrust block concrete. Paint restraint devices with 2 coats of corrosion resistant black asphalt base coating prior to backfilling.
- .4 Lay pipes true to line and grade with bells upgrade. Fit sections together so that, when complete, pipe has a smooth and uniform invert. Keep pipe thoroughly clean so jointed compound will adhere. Inspect pipe for defects before being lowered into trench.
- .5 Slope piping so it can be completely drained.
- .6 Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe or equipment.

3.04 Installation of Shut-Off and Check Valves

- .1 Refer to Part 3 of Section 20 05 00 – Common Work Results for Mechanical.
- .2 For shut off valves installed on solder joint copper piping up to and including 75 mm (3") diameter, provide ball type valves, and for flanged joints copper or stainless steel piping larger than 75 mm (3") diameter provide butterfly type valves.

3.05 Installation of Drain Valves

- .1 Provide a drain valve at the bottom of domestic water piping risers, at other piping low points, and wherever else shown.

- .2 Locate drain valves so they are easily accessible.

3.06 Installation of Domestic Hot Water Piping Balancing Valves

- .1 Provide balancing valves in domestic hot water recirculation piping where shown or required.
 - .1 for pipe 25 mm (3/4") dia. and less ground – equal to Victaulic Series 76X
 - .2 for pipe greater than 25 mm (3/4") dia. – equal to Victaulic TA Series 78BL
- .2 Locate each valve so it is easily accessible.

3.07 Installation of Partition Stops

- .1 Provide partition stops in domestic water piping to each group of suite washroom plumbing fixtures. Locate partition stops in piping near floor level in inconspicuous but accessible locations. Confirm exact locations prior to roughing-in.

3.08 Installation of Pressure Reducing Valves

- .1 Provide domestic water pressure reducing valves. Install so each valve is readily accessible. Whenever possible, provide pressure reducing valves factory pre-set to required pressures.
- .2 Check and test operation, and adjust as required.

3.09 Installation of Domestic Hot Water Thermostatic Mixing Valves

- .1 Provide a domestic hot water thermostatic mixing valve assembly and wall mount.
- .2 Adjust each valve to design requirements and check and test operation. Set maximum temperature limit stops.
- .3 Identify each valve and its water temperature delivery setting with an engraved nameplate.

3.10 Installation of Water Meter

- .1 Provide domestic water service meter. Secure meter in place on a concrete housekeeping pad and connect with piping, including required valve by-pass.
- .2 Installation of water meter must comply with local municipal requirement.

3.11 Installation of Hose Bibbs

- .1 Provide hose bibbs.
- .2 Unless otherwise shown, specified, or required, mount hose bibbs approximately 1 m (3') above floor. Confirm exact locations prior to roughing-in.

3.12 Installation of Exterior Non-Freeze Wall Hydrants

- .1 Provide non-freeze wall hydrants.
- .2 Install hydrants level and plumb such that hose outlets are approximately 600 mm (2') above grade level. Confirm exact locations prior to roughing-in.
- .3 Provide a shut-off valve inside building to each exterior non-freeze wall hydrant.

3.13 Installation of Exterior Non-Freeze Ground Hydrants

- .1 Provide non-freeze ground hydrants. Confirm exact locations prior to roughing-in.

- .2 Ensure length of piping to outlet box suits depth of underground piping, and underground piping elbow and valve housing is set in an envelope of clean sharp, 100% Proctor density compacted sand. Provide a length of small bore copper tubing from valve drain port into sand envelope.
- .3 Provide a shut-off valve inside building to each ground hydrant.

3.14 Installation of Non-Freeze Roof Hydrant

- .1 Provide non-freeze roof hydrants. Confirm exact locations prior to roughing-in.
- .2 Coordinate installation with trades providing roof opening and roofing work to ensure a water-tight roof penetration.
- .3 Provide 3.2 mm (1/8") diameter drain piping from inlet connection assembly inside building to a funnel floor drain or other suitable indirect connection location.

3.15 Installation of Trap Seal Primers

- .1 Provide required accessible trap seal primers to automatically maintain a water seal in floor drain traps, whether shown on drawings or not.
- .2 Water closet flush valves may be used for priming washroom floor drain traps if flush tube is properly tapped and primer tubing exposed in washroom is chrome plated.
- .3 Provide trap primer valves to prime single or multiple (1 to 6) traps. Install trap primer valves in domestic cold water piping to frequently used plumbing fixtures. Where from 2 to 6 traps are to be primed from same primer valve, provide appropriate supply and distribution tube assemblies. Ensure primer valves are accessible.
- .4 Provide 115 volt, electronic, surface wall mounting trap primer assemblies for multiple (4 to 30) traps. Include for a 115 volt 15 ampere panel breaker and wiring in conduit from closest panelboards to primer assembly, all to wiring standards of Electrical Division. Adjust primer water flow and timing to suit number of traps served.
- .5 Ensure trap primer piping is secured to floor drain primer tappings and not terminated through the tapping in the throat of the drain.

3.16 Installation of Shock Absorbers

- .1 Provide accessible shock absorbers in domestic water piping.
- .2 Ensure size of each shock absorber is properly selected to suit size of domestic water pipe and equipment pipe is connected to.

3.17 Installation of Water Hammer Arrestors

- .1 Provide accessible water hammer arrestors in domestic water piping in locations as follows:
 - .1 in headers at groups of plumbing fixtures;
 - .2 at top of risers;
 - .3 at ends of long horizontal runs of piping;
 - .4 in piping connecting solenoid valves or equipment with integral solenoid valves;
 - .5 wherever else shown or required by Code.
- .2 Install each unit in a piping tee either horizontally or vertically in the path of potential water shock in accordance with manufacturer's instructions and details.

3.18 Installation of Backflow Preventers

- .1 Provide a reduced pressure zone assembly backflow preventer on incoming DCW service and in each direct domestic water connection to equipment other than plumbing fixtures and fittings.
- .2 Provide a double check valve assembly backflow preventer on incoming DCW service. Provide a reduced pressure zone assembly backflow preventer in each direct domestic water connection to equipment other than plumbing fixtures and fittings.
- .3 Locate each backflow preventer on floor or wall between 765 mm and maximum 1.5 m (30" and 60") above floor such that it is easily accessible for maintenance and testing. Equip each backflow preventer with an air gap fitting and pipe the reduced pressure zone water outlet to drain.
- .4 Test operation of each backflow preventer in accordance with requirements of CAN/CSA B64 by personnel certified for such testing by governing authorities, and submit signed test results and a properly and clearly identified and marked inspection and test record card for each backflow preventer.

3.19 Installation of Expansion Compensators, Guides, and Anchors

- .1 Provide expansion compensators in domestic water piping.
- .2 Ensure pipe ends are properly aligned. Provide alignment guides on each side of expansion compensators, properly secured to building structure.
- .3 Provide anchors to secure domestic water piping to structure. Locate anchors generally where shown but with exact locations to suit piping as installed and requirements of reviewed anchor shop drawings.
- .4 When installation of anchors is complete, arrange, and pay for anchor design engineer to visit site to review anchor installation. Submit a letter from design engineer confirming each anchor is properly installed.

3.20 Installation of Lavatory Supply Fitting Tempering Valves

- .1 Provide thermostatic water tempering valves for hot water supply to public washroom lavatory supply fittings. Conceal valves and piping.
- .2 Provide a flush wall mount panel for each valve. Confirm exact location prior to roughing-in.
- .3 Install in accordance with manufacturer's instructions and set mixing valves to deliver 32°C (90°F) tempered water.

3.21 Installation of Air Vents

- .1 Provide accessible air vents in domestic water piping to prevent air binding.
- .2 Extend copper indirect drain piping from top drain connection of each vent to nearest suitable drain.
- .3 Locate exact vent locations on as-built record drawings.

3.22 Installation of Domestic Water Thermal Expansion Tank

- .1 Provide domestic water thermal expansion tanks.
- .2 Unless otherwise specified, mount at least 450 mm (18") from cold water inlet to domestic water heater.
- .3 Adjust pre-charge to match incoming water pressure after installation.
- .4 Install in accordance with manufacturer's instructions and as per local governing Codes and Regulations.

3.23 Flushing and Disinfecting Piping

- .1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.

- .2 Isolate new piping from existing piping prior to flushing and disinfecting procedures.
- .3 Flush piping until all foreign materials have been removed and flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.
- .4 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with AWWA C601.
- .5 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of test results and fill the systems.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings.

1.02 Closeout Submittals

- .1 Submit a copy of plumbing inspection certificate prior to application for Substantial Performance of the Work.
- .2 Submit letters from product manufacturers/suppliers to certify correct installation of products as specified in Part 3 of this section.

2 Products

2.01 Pipe, Fittings, and Joints

- .1 PVC Sewer
 - .1 DR35 rigid, green PVC hub and spigot pattern sewer pipe and fittings to CAN/CSA B182.2, with gasket joints assembled with pipe lubricant.
 - .2 DR35 rigid, PVC sewer pipe and fittings, with solvent weld joints, all certified to CSA B182.1 and colour-coded as per local governing codes, regulations and standards.
- .2 PVC - DWV
 - .1 Equal to Ipex System XFR 15-50 rigid PVC drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating less than 25 and a smoke developed rating less than 50 when tested to CAN/ULC S102.2, solvent weld joints, and, for fire barrier penetration, approved firestop conforming to CAN/ULC S115.
- .3 Copper - Solder Joint
 - .1 Type DWV hard temper to ASTM B306, with forged copper solder type drainage fittings and 50% lead - 50% tin solder joints.
- .4 Cast Iron
 - .1 Class 4000 cast iron pipe, fittings, and mechanical coupling joints to CAN/CSA B70.
- .5 Copper-Victaulic Coupling Joint
 - .1 Type DWV hard temper to ASTM B306, with factory or site rolled grooved ends (with grooving rolls designed for copper) and Victaulic "Copper Connection" wrought copper or cast bronze fittings and Style 606 gasket type couplings.
- .6 Galvanized Steel - Victaulic Coupling Joint
 - .1 Schedule 40 mild steel, galvanized, ASTM A53, factory or site rolled grooved, complete with Victaulic galvanized ductile iron grooved end fittings and, unless otherwise specified, Victaulic Style 77 hot dip galvanized mechanical joint couplings with Grade M gaskets.
- .7 PVC Weeper Piping
 - .1 150 mm (6") dia. corrugated perforated PVC pipe with an integral geodesic sock, supplied in coils.

2.02 Shut-Off and Check Valves

- .1 Shut-off Valves

- .1 Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass body, blowout-proof stem, chrome plated solid brass ball, solder or screwed ends as required, and removable lever handle.
- .2 Acceptable products are:
 - .1 Toyo Valve Co. Fig. 5049A or Fig. 5044A;
 - .2 Milwaukee Valve Co. #BA-155 or #BA -125;
 - .3 Kitz Corporation Code 58 or Code 59;
 - .4 Victaulic Co. of Canada Ltd. Series 722;
 - .5 Apollo Valves # 77-100 or # 77-200;
 - .6 Watts Industries (Canada) Inc. #FBVS-3C.
- .2 Check Valves
 - .1 Class 125, bronze, 1725 kPa (250 psi) WOG rated vertical lift check valve with solder or screwed ends as required, and, for horizontal piping, Class 125, bronze 1380 kPa (200 psi) WOG rated swing check valves with solder or screwed ends.
 - .2 Acceptable products are:
 - .1 Toyo Valve Co. Fig. 231 or Fig. 236 or Fig. 237;
 - .2 Milwaukee Valve Co. #1510 or #510;
 - .3 Kitz Corporation Code 36 or Code 22 or Code 23.

2.03 Vent Stack Covers

- .1 Equal to Lexcor Model "Flash-Tite" seamless, spun aluminum, insulated vent stack covers with caps and a factory applied asphalt primer coating on top and bottom of flange.
- .2 Each vent stack cover is to be complete with a vandal-proof cap.

2.04 Cleanouts

- .1 Horizontal Piping
 - .1 TY pipe fitting with an extra heavy brass plug screwed into the fitting.
- .2 Vertical Piping
 - .1 Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.
- .3 Urinal(s)
 - .1 Wall access cleanout assemblies, each complete with a tapered plug, threaded brass insert, urethane rubber seal, and polished stainless steel access cover with vandal-proof stainless steel securing screw.
 - .2 Acceptable products are:
 - .1 Watts Industries (Canada) Ltd. #CO-590-RD.
 - .2 Jay R. Smith #SQ4-1819;

- .3 Zurn #ZSS-1666-1;
- .4 Mifab #C1440-RD;

2.05 Floor Cleanout Terminations

- .1 Factory finished cast iron terminations, each adjustable and complete with a cast iron body with neoprene sleeve, solid, gasketed, polished nickel-bronze scoriated top access cover to suit floor finish, a seal plug, and captive, vandal-proof, stainless steel securing hardware.
- .2 Acceptable products are:
 - .1 Watts Industries (Canada) Ltd. # CO-200-R-1.
 - .2 Jay R. Smith #4020-F-C Series;
 - .3 Zurn # ZN-1602-SP Series;
 - .4 Mifab # C1100-XR-1 or #C1000-R-3;
- .3 Cleanout terminations in areas with a tile or sheet vinyl floor finish are to be as above but with a square top in lieu of a round top.

2.06 Floor Drains, Funnel Floor Drains, and Hub Drains

- .1 Unless otherwise specified or indicated, floor drains are to be vandal-proof drains in accordance with drawing symbol list, each complete with a cast iron body and a trap seal primer connection. Cast iron components are to be factory finished with latex based paint coating.
- .2 Floor drains in areas with a tile or sheet vinyl floor finish are to be as above but with a square grate in lieu of a round grate.
- .3 Acceptable manufacturers are:
 - .1 Watts Industries (Canada) Ltd.;
 - .2 Jay R. Smith Manufacturing Co.;
 - .3 Zurn Industries Ltd.;
 - .4 Mifab Inc.

2.07 Roof Drains

- .1 Unless otherwise specified or indicated, roof drains are to be cast iron body drains with aluminium domes, in accordance with the drawing symbol list. Cast iron components are to be factory finished with a latex based paint coating.
- .2 Acceptable manufacturers are:
 - .1 Watts Industries (Canada) Ltd.;
 - .2 Jay R. Smith Manufacturing Co.;
 - .3 Zurn Industries Ltd.;
 - .4 Mifab Inc.

2.08 Drainage Trench Frames and Grating

- .1 Welded, hot dipped galvanized, 45 mm x 45 mm x 6.4 mm (1-³/₄" x 1-³/₄" x ¹/₄") carbon steel angle frame, 300 mm (12") wide, with anchor straps and lengths as required, and baked epoxy coated cast iron slotted grating in 600 mm (24") long sections.

- 2 Acceptable products are:
 - .1 Watts Industries (Canada) Ltd. #TD-910-B1-4;
 - .2 Jay R. Smith #2971VP.
 - .3 Zurn # Z796VP;

2.09 Trench Drains

- .1 Modular, pre-sloped, polyester fibreglass construction interlocking sections of drainage channel with overlapping joints, drain pipe connection outlets as required, end caps and covers to suit the application, integral anchor tabs for grate anchoring and trench levelling, heavy-duty coated steel angle top frames, and heavy-duty coated cast iron slotted grate supplied in 600 mm (24") long sections.
- .2 Acceptable products are:
 - .1 Watts Industries (Canada) Inc. "Dead Level" Series;
 - .2 Jay. R. Smith #9810 Series.
 - .3 Zurn "Flow-Thru" System;
 - .4 ACO Systems Ltd. "ACODrain";

2.10 Interior Catch Basin Frames and Covers

- .1 Heavy-duty, 508 mm (13") square, baked epoxy coated cast iron, non-removable, hinged slotted grate with coated steel frame with concrete anchors.
- .2 Acceptable products are:
 - .1 Watts Industries (Canada) Ltd. #FD-410;
 - .2 Jay R. Smith #8915FC;
 - .3 Zurn #Z-799-1;
 - .4 Mifab #F1570.

2.11 Backwater Valves

- .1 Heat bonded powder epoxy coated cast iron in-line type, each complete with a bolted and gasketed cover, bronze flapper, stainless steel extension, and stainless steel hardware.
- .2 Acceptable products are:
 - .1 Watts Industries (Canada) Inc. BV-230-R Series;
 - .2 Jay R. Smith #7022-CAN.
 - .3 Zurn #Z-1095-15-MJ;

2.12 Exterior Catch Basins

- .1 Pre-cast reinforced concrete catch basins manufactured to ASTM C478 and Municipal standards, each sized and arranged to suit drainage pipe size and arrangement, and complete with:
 - .1 cast iron frame and cover to Municipal standards;

.2 required masonry work to raise top of catch basins flush with finished grade or pavement surfaces.

.2 Masonry work is to consist of cement mortar and clay or shale bricks to ASTM C32 Grade M5, or Oaks Precast Industries "MODULOC" pre-cast interlocking concrete members and accessories.

2.13 Exterior Manholes

.1 Pre-cast reinforced concrete manholes manufactured to ASTM C478 and Municipal standards, each sized and arranged to suit drainage pipe size and arrangement, and complete with:

.1 poured-in-place or pre-cast concrete base;

.2 cast-in-place "Safety" type aluminum steps on 300 mm (12") centres, each step coated with 2 coats of static asphalt paint;

.3 unperforated cast iron cover with lifting holes and a matching frame;

.4 as required by manhole depth and safety regulations, cast-in-place hinged aluminum safety grating with SG 1 1 R-T6 aluminum alloy bearing bars, aluminum grate to CAN/CSA S157, and self-locking type stainless steel hinges and fasteners with galvanized steel safety chain and snap hook;

.5 required masonry work to raise top of manholes flush with finished grade.

.2 Masonry work is to consist of cement mortar and clay or shale bricks to ASTM C32 grade M5, or Oaks Precast Industries "MODULOC" pre-cast interlocking concrete members and accessories.

2.14 Grease Interceptor

.1 Grease intercepting and recovery unit of #11 gauge type 304 stainless steel construction with sensor controlled grease draw-off solenoid valve, automatic shut-down with audible/visual alarm if maximum grease capacity is exceeded, integral heating element with thermostat, gasketed stainless steel cover, stainless steel solids interceptor, and remote surface wall mounting indicator panel with status indicating lights, audible alarm, 115/24 volt control transformer and NEMA 2 enclosure.

.2 Acceptable products are:

.1 Watts Industries (Canada) Inc. WD-E Series;

.2 Jay R. Smith #8000-ELECT series or #8400-ELECT series.

.3 Zurn #Z1172-UN series;

2.15 Oil Interceptor

.1 Epoxy coated steel construction automatic oil interceptor with removable baffles, deep seal trap with cleanout, sediment bucket, aluminum frame and cover, and remote wall mounting indicating panel with status indicating lights, audible alarm, 115/24 volt control transformer, and NEMA 2 surface wall mounting enclosure.

.2 Acceptable products are:

.1 Watts Industries (Canada) Inc. OI-SS / HI 7873 Series;

.2 Jay R. Smith 8500-SC-ELECT-CAN Series.

.3 Zurn #Z1198 series;

3 Execution

3.01 Demolition

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Underground Municipal Service Connection

- .1 Make required arrangements with Municipality for installation of drain service piping mains from Municipal main to property line.
- .2 Pay charges levied by Municipality for service connection work.
- .3 Municipal charges for underground street service connection work will be paid out of a prime cost allowance. Submit original copies of invoices issued by Municipality for street service connection work.

3.03 Drain and Vent Piping Installation Requirements

- .1 Provide required drainage and vent piping. Pipe, unless otherwise specified, as follows:
 - .1 for underground pipe inside building and to points 1.5 m (5') outside building lines – rigid PVC sewer pipe, minimum 75 mm (3") dia.;
 - .2 for pipe inside building and aboveground in sizes less than or equal to 65 mm (2-½") dia. – type DWV copper;
 - .3 for pipe inside building and aboveground in sizes greater than or equal to 75 mm (3") dia. – Class 4000 cast iron;
 - .4 for pipe inside building and aboveground in lieu of type DWV copper and cast iron, at your option and where permitted by governing Codes and Regulations – rigid PVC DWV;
 - .5 for drainage pump discharge pipe connections from pump to and including shut-off and check valve connections – Type "DWV" copper with Victaulic "Copper Connection" fittings and couplings, or Schedule 40 galvanized steel with Victaulic fittings and couplings.
- .2 Unless otherwise specified, slope horizontal drainage piping aboveground in sizes to and including 75 mm (3") dia. 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") dia. and larger 25 mm (1") in 2.4 m (8').
- .3 Install and slope underground drainage piping to inverts or slopes indicated on drawings to facilitate straight and true gradients between points shown. Verify available slopes before installing pipes.
- .4 Unless otherwise specified, slope horizontal branches of vent piping down to fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4').
- .5 Extend vent stacks up through roof generally where shown but with exact locations to suit site conditions and in any case a minimum of 3 m (10') from fresh air intakes. Terminate vent stacks a minimum of 330 mm (13") above roof (including roof parapets) in vent stack covers. Where not shown on drawings, route vent piping from source to building exterior as required in order to satisfy local governing codes and authority. Coordinate vent routing with other building services and ensure there is no architectural impact.
- .6 Provide cast brass dielectric unions at connections between copper pipe and ferrous pipe or equipment.

3.04 Installation of Shut-Off and Check Valves

- .1 Provide a shut-off valve and a check valve in discharge piping of each drainage pump.
- .2 Locate valves so they are easily accessible without the use of ladders or other such devices.

3.05 Supply of Vent Stack Covers

- .1 Supply a properly sized vent stack cover for each vent stack penetrating roof.

- .2 Hand vent stack covers to roofing trade at site for installation and flashing into roof construction as part of roofing work. Coordinate installation to ensure proper locations. Provide waterproofing caps over vent stacks.

3.06 Installation of Cleanouts

- .1 Provide cleanouts in drainage piping in locations as follows:
 - .1 in building drain or drains as close as possible to inner face of outside wall, and, if a building trap is installed, locate cleanout on downstream side of building trap;
 - .2 at or as close as practicable to the foot of each drainage stack;
 - .3 at maximum 15 m (50') intervals in horizontal pipe 100 mm (4") dia. and smaller;
 - .4 at maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") dia.;
 - .5 in the wall at each new urinal or bank of urinals in a washroom;
 - .6 wherever else shown on drawings.
- .2 Cleanouts are to be same diameter as pipe in piping to 100 mm (4") dia., and not less than 100 mm (4") dia. in piping larger than 100 mm (4") dia.
- .3 Where cleanouts in vertical piping are concealed behind walls or partitions, install cleanouts near floor and so cover is within 25 mm (1") of the finished face of the wall or partition.

3.07 Installation of Floor Cleanout Terminations

- .1 Where cleanouts occur in horizontal inaccessible underground piping, extend cleanout TY fitting up to floor, and provide a cleanout termination set flush with finished floor.
- .2 In waterproof floors, ensure each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit floor finish.
- .3 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.
- .4 Ensure cleanout termination covers in tiled floor are square in lieu of round.

3.08 Installation of Floor Drains, Funnel Floor Drains and Hub Drains

- .1 Provide floor drains, funnel floor drains and hub drains.
- .2 Coordinate location of floor drains, funnel floor drains and hub drains with equipment provided by Mechanical Division and Owner's supplied equipment. Install in accordance with manufacturer's instructions.
- .3 Equip each drain with a trap.
- .4 In equipment rooms and similar areas, exactly locate floor drains to suit location of mechanical equipment and equipment indirect drainage piping. In washrooms, exactly locate floor drains to avoid interference with toilet partitions.
- .5 Confirm exact location of drains prior to roughing in. Where floor drains occur in washrooms coordinate locations with toilet partition installations.
- .6 Temporarily plug and cover floor drains during construction procedures. Remove plugs and covers during final clean-up work and when requested, demonstrate free and clear operation of each drain. Replace any damaged grates, and refinish any areas of the drain where cast iron finish has been damaged or removed, including rusted areas.

3.09 Installation of Roof Drains

- .1 Supply roof drains and place roof drain bodies in position for flashing into roof construction as part of roofing work. Connect with piping and provide accessories.
- .2 Protect roof drains from damage and entrance of debris until roofing work is complete, and refinish any areas where cast iron factory finish has been damaged or removed, including rusted areas.

3.10 Installation of Drainage Trench Frames and Grating

- .1 Supply frame and grating sections for drainage trench. Provide piping connections, traps, etc., as required.
- .2 Hand frames to concrete trade forming and pouring trenches. Ensure frames are properly and accurately installed.
- .3 Be present during concrete pour to ensure frames are not dislodged or damaged and remain straight and true. Immediately report any problems.
- .4 Install grates and secure in place. Temporarily cover grates during construction procedures. Clean trenches when work is complete.

3.11 Installation of Trench Drains

- .1 Provide pre-sloped sections of drainage channel and install so top frames are level and plumb in relation to floor finishes. Provide accessories, traps, etc., as required.
- .2 Be present during concrete pour to ensure trench drainage is not dislodged or damaged and remains straight and true. Immediately report any problems.
- .3 Install grating and secure in place.
- .4 Temporarily cover trench drainage openings during construction procedures. Clean trenches when work is complete.

3.12 Installation of Interior Catch Basin Frames and Covers

- .1 Supply frames and hinged grates for interior catch basins and provide sump inlet and outlet piping and accessories.
- .2 Hand frames to concrete trade pouring concrete sump, and coordinate installation of sump piping with the formwork installation.
- .3 Install grates and secure in place. Clean sumps when work is complete.

3.13 Installation of Backwater Valves

- .1 Provide backwater valves in drainage piping and connect with piping.
- .2 Set backwater valve assembly such that cover is flush with finished floor. Provide an extension piece if required due to depth of piping.

3.14 Installation of Exterior Manholes

- .1 Provide pre-cast concrete manholes. Properly bed each unit and set to required invert.
- .2 Provide a reinforced pre-cast concrete base slab and bottom section for each manhole, or provide a poured-in-place concrete base. Ensure each manhole is sized to suit pipe size and arrangement. Conform to Municipal installation standards.
- .3 Provide masonry work required to raise top of each assembly flush with finished grade level.
- .4 When work is substantially complete, clean out each manhole.

3.15 Installation of Exterior Catch Basins

- .1 Provide pre-cast concrete catch basins. Properly bed each unit and set to required invert.
- .2 Ensure each catch basin is sized to suit pipe size and arrangement. Conform to Municipal installation standards.
- .3 Provide masonry work required to raise top of each assembly flush with finished grade level.
- .4 When work is substantially complete, clean out each catch basin.

3.16 Installation of Drainage Interceptor

- .1 Provide an interceptor in drainage piping.
- .2 Ensure unit is easily accessible for maintenance. Confirm exact location prior to roughing-in.
- .3 Wall mount control panel and provide required 24 volt control wiring in conduit from control panel to interceptor.
- .4 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system start-up requirements.
- .5 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system manufacturer certification requirements. Submit a copy of the letter prior to Substantial Performance of the Work.
- .6 Include for 2 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 Submittals

- .1 Submit product data sheets (fixture cuts) for all plumbing fixtures and fittings.
- .2 Submit fixture manufacturer's standard colour charts for all fixtures where colours are available but a particular colour is not specified.

2 Products

2.01 General Re: Plumbing Fixtures and Fittings

- .1 Fixtures and fittings, where applicable, are to be in accordance with requirements of CAN/CSA B45 Series, General Requirements for Plumbing Fixtures, including supplements, ASME A112.1.18.1/CSA B125.1, Plumbing Supply Fittings, and CSA B125.3, Plumbing Fittings.
- .2 Barrier-free fixtures and fittings are to be in accordance with governing Code requirements.
- .3 Unless otherwise specified, vitreous china, porcelain enamelled, and acrylic finished fixtures are to be white.
- .4 Unless otherwise specified, fittings and piping exposed to view are to be chrome plated and polished.
- .5 Fittings located in areas other than private washrooms are to be vandal-proof.
- .6 Fixture carriers are to be suitable in all respects for the fixture they support and construction in which they are located.
- .7 Floor flanges for floor mounted water closets are to be cast iron or brass, secured to floor to prevent movement and complete with a wax seal and brass or stainless steel bolts, nuts, and washers. Plastic floor flanges will not be acceptable.
- .8 Proper seal to mate with fixture carrier flange and produce a water-tight installation.
- .9 Exposed traps for fixtures not equipped with integral traps, such as lavatories, are to be adjustable chrome plated cast brass "P" traps with cleanouts, minimum #17 gauge chrome plated tubular extensions, and chrome plated escutcheons, all to suit fixture type and drain connection.
- .10 Concealed traps for fixtures not equipped with integral traps, such as counter sinks, are to be adjustable cast brass with cleanout plugs, all to suit fixture type and drain connection.
- .11 Exposed supplies for fixtures which do not have supply trim/fittings with integral stops, i.e. lavatories, are to be solid chrome plated brass angle vales with screwdriver stops for public areas, wheel handle stops for private areas, flexible stainless steel risers, and stainless steel or chrome plated steel escutcheons, all arranged and sized to suit fixture.
- .12 Water piping as specified, complete with ball type shut-off valves as specified with water piping, or Dahl Bros. Canada Ltd. ¼ turn Mini Ball Valves.

2.02 Plumbing Fixtures and Fittings

- .1 Plumbing fixtures and fittings are to be in accordance with the following:
 - .1 **S-1 - Classroom Single Bowl Stainless Steel Sink**
 - .1 **Franke Commercial #LBS6408P-1/3 Single Bowl Countertop Mount Sink**, 1 hole, 410 mm (16-1/8") wide x 522 mm (20-9/16") long x 203 mm (8") high deep, Counter mounted, backledge, Grade 18-10 18 GA. (1.2 mm) type 304 stainless steel, self-rimming, Satin finish rim and bowls, Mounting kit provided, Fully undercoated to reduce condensation and resonance, factory applied rim seal, 3-1/2" (89 mm) crumb cup waste assembly with 1-1/2" (38 mm) tailpiece.

- .2 **Chicago Faucets #430-ABCP Single handle Faucet**, Chrome plated finish, Center hole only, ECAST construction lead free (equal or less than 0.25%) ECAST brass construction, ceramic volume control and Hot Water Limit Stop cartridge, 5.7 LPM (1.5 GPM) pressure compensating Laminar Flow (non-aerating) outlet, 241 mm (9-1/2") projection rigid cast brass spout, Single metal lever handle.
- .3 **McGuire #LFBV170 Faucet Supplies**, Chrome plated finish polished brass, commercial duty 1/4 turn ball valve angle stops, 13 mm (1/2") I.D. Inlet x 127 mm (5") horizontal extension tubes, convertible 1/4 turn/loose key handles, Escutcheon and flexible copper risers.
- .4 **McGuire #8912CB P-Trap**, heavy cast brass adjustable body, with slip nut, 38 mm (1-1/2") size, Box flange and Seamless tubular wall bend. Revise following article accordingly.

2.03 Acceptable Manufacturers

- .1 Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, following:
 - .1 Flush Valves:
 - .1 Sloan;
 - .2 Delta Commercial;
 - .3 Zurn Industries;
 - .4 Moen Commercial.
 - .2 Plumbing Brass:
 - .1 Sloan;
 - .2 Acorn Engineering;
 - .3 American Standard;
 - .4 Delta Commercial;
 - .5 Chicago Faucet;
 - .6 Moen Commercial.
 - .3 Stainless Steel Sinks:
 - .1 Franke Commercial;
 - .2 Novanni Commercial;
 - .3 Aristaline;
 - .4 Arch Metal Ind.
 - .4 Mop Sinks:
 - .1 Stern Williams;
 - .2 Acorn Engineering;
 - .3 Zurn Industries.

- .5 Emergency Eye Wash and Emergency Showers:
 - .1 Haws;
 - .2 Speakman;
 - .3 Bradley.
- .6 Drain Fittings, Angle Supplies, and Traps:
 - .1 McGuire;
 - .2 American Standard;
 - .3 Delta Commercial;
 - .4 Zurn Industries.
- .7 Fixture Carriers:
 - .1 Watts Industries;
 - .2 Jay R. Smith;
 - .3 Zurn Industries.
- .8 Hose Bibbs:
 - .1 Jay R. Smith;
 - .2 Zurn Industries.
- .9 Water Closets, Lavatories, and Urinal:
 - .1 American Standard;
 - .2 Zurn Industries;
 - .3 Kohler.
- .10 Thermostatic Mixing Valves:
 - .1 Lawler;
 - .2 Delta Commercial;
 - .3 Leonard.
- .11 Shower and Associated Trim:
 - .1 American Standard;
 - .2 Delta Commercial;
 - .3 Zurn Industries;
 - .4 Moen Commercial.
- .12 Toilet Seats:

- .1 Olsonite;
- .2 Centoco;
- .3 Bemis Commercial.
- .13 Electronic “No Touch” Flush Valves:
 - .1 Sloan;
 - .2 Delta Commercial;
 - .3 Zurn Industries;
 - .4 Moen Commercial.
- .14 Electronic “No Touch” Faucets:
 - .1 Sloan;
 - .2 Delta Commercial;
 - .3 Zurn Industries;
 - .4 Moen Commercial.

2.04 Caulking

- .1 General Electric Series SCS-1200 Silicone Construction Sealant or Dow Corning 780 silicone rubber sealant with primers as recommended by sealant manufacturer. Caulking colour(s) for coloured fixtures other than white, if any, will be selected by Consultant from sealant manufacturer’s standard colour range.

3 Execution

3.01 Demolition

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Installation of Plumbing Fixtures and Fittings

- .1 Provide required plumbing fixtures and fittings.
- .2 Where new fixtures and fittings are to be connected to existing piping, include for required piping revisions.
- .3 Connect plumbing fixtures and fittings with piping sized in accordance with drawing schedule. Refer to manufacturer's published connection (rough-in) requirements. Where manufacturer requires piping connection larger than shown below, provide piping accordingly:

FIXTURE AND/OR FITTING	DRAIN SIZE MM (IN.)	VENT SIZE MM (IN.)	DHW SIZE MM (IN.)	DCW SIZE MM (IN.)	TEMP WATER SIZE MM (IN.)
Water Closets Flush Valve Type	100 (4)	38 (1-½)	-----	25 (1)	-----
Urinals	75 (3)	38 (1-½)	-----	25 (1)	-----
Lavatories	32 (1-¼)	32 (1-¼)	12 (½)	12 (½)	-----

FIXTURE AND/OR FITTING	DRAIN SIZE MM (IN.)	VENT SIZE MM (IN.)	DHW SIZE MM (IN.)	DCW SIZE MM (IN.)	TEMP WATER SIZE MM (IN.)
Lavatories (Electronic Faucet)	32 (1-¼)	32 (1-¼)	12 (½)	12 (½)	12 (½)
Counter Sinks	38 (1-½)	32 (1-¼)	12 (½)	12 (½)	-----
Shower Valves and Heads	-----	-----	12 (½)	12 (½)	12 (½)
Shower Stalls	50 (2)	38 (1-½)	12 (½)	12 (½)	12 (½)
Prefab. Mop Sinks with Drain	75 (3)	38 (1-½)	20 (¾)	20 (¾)	-----
Emergency Eye Wash	-----	-----	-----	-----	12 (½)
Emergency Shower	-----	-----	-----	-----	25 (1)

- 4 Confirm exact location of plumbing fixtures and trim prior to roughing-in. Refer to architectural plan and elevation drawings.
- 5 When installation is complete, check, and test operation of each fixture and fitting. Adjust or repair as required.
- 6 For barrier-free fixtures, comply with mounting height and other requirements of governing Code(s).
- 7 Supply templates for counter mounted fixtures and trim and hand to trades who will cut the counter. Ensure openings in counter are properly located.
- 8 Locate control panels for electronic faucets under lavatories and recessed into wall. Coordinate panel installations with electrical trade who will provide 115 volt power wiring to panels. Install flexible conduit (supplied with box) and extend cord from faucet through the flexible conduit to control box. Connect hot and cold water piping to mixing valve in each box, and tempered water piping from each mixing valve to faucet. Set mixing valve maximum temperature limit stops to 43°C (110°F) after domestic water systems (hot and cold) are complete. Ensure each programmable controller is properly programmed and water off after deactivation is set for 3 seconds.
- 9 For electronic flush valves, locate transformer in ceiling space above electronic units to be served. Coordinate locations with electrical trade who will provide 120 volt line supply to transformers. Provide low voltage wiring from transformers to each electronic flush valve terminal point. Electrical line supply and low voltage wiring is to be concealed and access to transformer must be provided for servicing.
- 10 Protect baths from damage during construction and finishing work. Unless otherwise specified, pack concealed voids under baths with batt type glass fibre insulation as baths are installed.
- 11 Protect shower bases from damage during construction and finishing work.
- 12 Confirm exact mixing valve and shower head locations prior to roughing-in.
- 13 Install refrigerated drinking fountains in accordance with manufacturer's instructions. Plug into a wall receptacle provided as part of electrical work. Coordinate receptacle installation with electrical trade on site.
- 14 For emergency showers, install so bottom of shower head is approximately 2 m (82") above floor, and approximately 400 mm (16") out from the wall. Wall mount mixing valve approximately 1.5 m (5') above floor and adjacent shower head. Set valve temperature limit stop to 35°C (95°F). Ensure valve is open and exposed piping is chrome plated or stainless steel.
- 15 Install eye wash fixtures in accordance with manufacturer's instructions. Ensure exposed piping is painted.
- 16 Wall mount mixing valves for emergency fixtures approximately 1.5 m (5') above floor and secure in place. Check and confirm valve operation and temperature of tempered water supply. Provide cabinets. Identify each cabinet and hand 3 identified cabinet keys to Consultant prior to Substantial Performance of the Work.

- .17 Set mop service basins on floor over drain piping and connect to roughed-in service. Install wall supply trim and any accessories specified.

3.03 Caulking at Plumbing Fixtures and Fittings

- .1 Caulk around plumbing fixtures and fittings where they contact walls, floors, and any other building surface.
- .2 Clean areas/surfaces to be caulked and prime in accordance with sealant manufacturer's instructions. Where damage to a building surface may occur, mask surface to prevent damage and ensure a clean exact edge to the caulking bead.
- .3 Apply caulking using a gun with proper size and shape of nozzle and force sealant into joints to ensure good surface contact and a smooth and even finished bead of sealant.
- .4 If joints have been masked sealant may be tooled in a continuous stroke to obtain complete void filling. Remove masking tape immediately after tooling and before sealant begins to skin.

3.04 Dishwasher Connections

- .1 Provide roughed-in water and drain connections for Owner supplied dishwasher consisting of:
 - .1 15 mm (1/2") dia. domestic hot water connection with a Dahl "Mini-Ball" valve with hose end and water hammer arrestor;
 - .2 40 mm (1-1/2") dia. DWV copper drain connection with "P" trap and cleanout plug.

3.05 Clothes Washer Connections

- .1 Provide roughed-in water and drain connections for Owner supplied clothes washer consisting of:
 - .1 15 mm (1/2") dia. piping connection for both hot and cold water, each terminated in a Dahl "Mini-Ball" Valve with hose end and water hammer arrestor;
 - .2 40 mm (1-1/2") dia. standing waste with a height to suit the washer drain and complete with a "P" trap.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data for all products specified in Part 2 of this section except for pipe, fittings, and unions. Indicate performance criteria, conformance to appropriate reference standards, and limitations.
- .2 For each gas pressure regulating station, submit:
 - .1 a selection sheet for each PRV, indicating connected equipment, heating loads, design allowance, meter model, body size, spring range and orifice size;
 - .2 a selection sheet for each relief valve(s) serving a PRV.

1.02 Quality Assurance

- .1 All gas system work is to be in accordance with requirements of CAN/CSA-B149.1, Natural Gas and Propane Installation Code, as amended by local Gas Codes.
- .2 All gas system work is to be performed only by licensed gas pipe fitters (holding Gas Technician 1 Certificate) authorized under the TSSA Act.
- .3 Apply for, on TSSA forms, approval of the gas system design by the TSSA prior to work beginning at the site and prior to ordering any equipment. Submit the completed TSSA Form and copies of shop drawings/product data sheets as required to the TSSA and obtain an approval certificate. Pay all costs for the TSSA review and approval process. If the TSSA requires revisions to the system and the revisions result in an extra cost, a Notice of Change will be issued by the Consultant for the revision.

2 Products

2.01 Pipe, Fittings and Joints

- .1 Coated Black Steel - Welded Joints: "Yellow Jacket" Schedule 40 mild black carbon steel, ASTM A53, Grade B, factory coated with yellow plastic, mill or site bevelled, and complete with forged steel butt welding fittings and welded joints. All bare metal surfaces are to be cleaned and corrosion protected with a suitable Denso primer and tape corrosion protection system.
- .2 Polyethylene: Safety yellow coloured polyethylene pipe, fittings, and joints to CSA-B137.4.
- .3 Coated Copper: Type "K" soft temper copper with a factory applied external yellow plastic coating and flare fittings with forged brass nuts to CAN/CSA-B149.1. Nuts are to be stamped with the designation C37700 to indicate that they are forged brass.
- .4 Uncoated Black Steel - Screwed Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with malleable cast iron screwed fittings to ANSI B2.1, and screwed joints.
- .5 Uncoated Black Steel - Welded Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, mill or site bevelled, complete with factory made forged steel butt welding fittings and welded joints.
- .6 Copper-Uncoated: Type "G" seamless copper tubing to ASTM B837, hard temper with wrought copper capillary brazed joint type fittings to ASTM B.61, and brazed joints made with "Sil-Fos" or "Sil-Fos 5" brazing alloy, or, soft temper with flared brass fittings of a single 45° flare type, forged or with a machined long nut and copper to copper threaded connectors, and, where required, flared brass copper to NPS adapters.
- .7 Flexible Stainless Steel: Flexible, CSA certified, 860 kPa (125 psi) rated, gas-tight, convoluted stainless steel tubing factory jacketed with a bright yellow PVC coating which is continuously identified. The tubing is to be supplied in coils and is to be complete with factory attached stainless steel end fittings, and adapter unions, protective plates, and steel clamps. Acceptable products are:
 - .1 Tru-Flex Metal Hose LLC. "Pro-Flex";

- .2 Titeflex Corp. "Gastite";
- .3 Omega Flex Canada "TracPipe".

2.02 Piping Unions

- .1 Screwed Piping: Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).
- .2 Flanged Piping: Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.
- .3 Copper to Steel: Equal to Kamco Products "Copper Stopper".

2.03 Shut-Off Valves

- .1 Ball Type: CSA certified, minimum 3100 kPa (450 psi) WOG rated, 1/4 turn, full port non-lubricated brass ball valves, each complete with a Teflon PTFE seat, chrome plated solid ball, removable lever handle, and screwed ends. Acceptable products are:
 - .1 Neo Valves Inc. #425;
 - .2 Kitz Corp. Code 58;
 - .3 Toyo Valve Co. Fig. 5044A.
- .2 Plug or Ball Type: CSA certified, plain face flanged, Class 125, 1380 kPa (200 psi) rated, 1/4 turn, cast iron lubricated plug valves, each wrench operated and complete with cylindrical plug with lubricant grooves, lubricant screw, and lubricant receptacle, or full port carbon steel ball valves with flanged ends. Acceptable products are:
 - .1 Neo Valves Inc. #1AS40114 plug valve;
 - .2 Newman Hattersley #171M plug valve;
 - .3 Kitz Corp. Code No. 150 SCTAM-FS-CGA ball valve.

2.04 Pressure Regulators

- .1 CSA certified pressure regulators as follows:
 - .1 non-vented type: lever action, dead end lockup type, each complete with a vent limiter, self-aligning valve, die-cast aluminium housing, and synthetic rubber compound diaphragm;
 - .2 vented type: spring-loaded self-operated design, tight closing, selected for the facility gas pressure and piping pressure loss, and connected equipment load at full firing rate plus 20% spare, and complete with:
 - .1 1035 kPa (150 psi) rated cast iron body finished with corrosive resistant epoxy enamel;
 - .2 aluminum diaphragm and spring case with Nitrile diaphragm, disc, and body o-ring;
 - .3 throttling type, high flow rate, tight shut-off relief valve selected to protect equipment downstream of the regulator in coordination with regulator capacity.
- .2 Acceptable manufacturers are:
 - .1 Maxitrol Co.;
 - .2 Fisher Controls;

- .3 Leslie Controls Inc.;
- .4 Lakeside Process Controls.

2.05 Natural Gas Piping Roof Supports

- .1 Bases and blocks are to be UV resistant.
- .2 Clamps for gas piping to be one (1) size larger than pipe to allow for expansion.
- .3 Clamps and screws to be galvanized.
- .4 Piping supports to be provided with two (2) year warranty.
- .5 Acceptable products are as follows:
 - .1 Pipe Ease – Quick Block – Polypropylene support block with rigid foam base;
 - .2 Mifab – CX/C Series – UV Resistant Recycled Rubber support with base;
 - .3 Nelson/Olsen – Quick Pipe Block – HDPE support with rigid foam base;
 - .4 Erico – Caddy Pyramid Series – Thermoplastic support with base.

3 Execution

3.01 Demolition

- .1 Do all required gas system demolition work. Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Natural Gas Service

- .1 Make all required arrangement with the natural gas supply utility on behalf of the Owner for installation of natural gas service piping with gas pressure regulator and meter assembly.
- .2 Provide an earthquake activated automatic shut-off valve in gas service piping outside the building in accordance with the valve manufacturer's installation instructions. Provide an angle iron framed wire mesh enclosure around the valve and bolted to the wall.
- .3 Provide 2 m (7') high minimum 200 mm (8") diameter Schedule 80 galvanized steel concrete filled bollards at the meter-regulator location in a pattern to protect the meter-regulator. Install the pipe straight and plumb a 1.2 m (4') below grade in a continuous 600 mm (2') diameter reinforced concrete footing. Smoothly crown the top of the concrete above the top of the pipe.

3.03 Natural Gas Piping Installation Requirements

- .1 Provide all required natural gas distribution piping and connect gas fired or operated equipment, and provide all required vent piping to atmosphere, including vent piping from pressure regulators. Do all piping work in accordance with requirements of CAN/CSA-B149.1, Natural Gas and Propane Installation Code, as amended by local Gas Codes.
- .2 Piping is to be as follows:
 - .1 for underground piping, coated Schedule 40 black steel, coated soft copper, or polyethylene;
 - .2 for above ground piping, uncoated Schedule 40 black steel, hard temper or soft copper, or, if permitted, flexible stainless steel.
- .3 Install flexible stainless steel pipe in strict accordance with the pipe manufacturer's printed instructions.

- .4 Slope gas piping in the direction of flow to low points.
- .5 Ensure that supports for roof mounted piping are sized (height) to accommodate the roof slope and the required piping slope, and to permit the installation of low point dirt pockets. Refer to mechanical details on drawings for more requirements.
- .6 Provide full pipe diameter 150 mm (6") long drip pockets at the bottom of all vertical risers, at all piping low points, and wherever else shown and/or required.
- .7 Identify all natural gas piping above ground with two coats of safety yellow enamel applied over primer, and SMS Ltd. or equal coil type vinyl identification makers with arrows.
- .8 For all underground gas piping, provide continuous 75 mm (3") wide yellow PVC warning tape with "CAUTION - GAS LINE BURIED BELOW" wording at 750 mm (30") intervals located above the pipe approximately 250 mm (10") below grade.
- .9 Rough-in all required natural gas piping for kitchen and laundry equipment in accordance with drawing plans and schedules. Obtain accurately dimensioned rough-in drawings for the equipment and confirm exact locations prior to roughing-in. When the equipment has been installed, connect the equipment from the roughed-in Work. Provide shut-off valves in all piping connections to the equipment.
- .10 Include for mounting only of a solenoid valve in the gas piping to kitchen cooking equipment.

3.04 Installation of Shut-Off Valves

- .1 Provide CSA approved ball type or lubricated plug type shut-off valves to isolate equipment, and wherever else shown.
- .2 Ensure that valves are located for easy accessibility and maintenance.

3.05 Installation of Natural Gas Convenience Outlets

- .1 Provide natural gas convenience outlets and wall mount.
- .2 Provide a shut-off valve in connecting piping, confirm exact location prior to roughing-in, and ensure that the outlet is rigidly secured in place.

3.06 Installation of Pressure Regulators

- .1 Provide pressure regulators in gas distribution piping where indicated and/or required.
- .2 For indoor appliances, use lever acting design vent limiter type, sized as shown and mounted in a horizontal upright position in strict accordance with the manufacturer's instructions. Note that these pressure regulators do not require vent piping.
- .3 Use vented type pressure regulators for all other applications.
- .4 Install regulating stations in accordance with requirements of CAN/CSA-B149.1.
- .5 Provide 6 mm (1/4") diameter test ports upstream and downstream of each regulator assembly.
- .6 Locate outdoor regulating stations a minimum of 300 mm (12") away from walkways, and 3 m (10') away from equipment air intakes and building openings. Provide all required vent piping and terminate vents in a turn-down elbow fitting with bronze bug screen secured in place.
- .7 Locate indoor regulating stations in locations accessible without the use of ladders or lifts. Combine vents where permitted and increase vent pipe size accordingly. Extend vent piping up through the roof 3 m (10') away from equipment air intakes and building openings and terminated in a turn-down elbow fitting with bronze bug screen secured in place.
- .8 Indicate operating set-points, relief settings and vent arrangements for each regulating station on as-built record drawings.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for all products specified in Part 2 of this section except for pipe and fittings.
- .2 Submit, in shop drawing form, a schematic piping diagram for each refrigerant piping system indicating pipe sizes, slopes, valves, traps, and piping specialties. Piping schematics must be reviewed, approved, and signed by refrigeration equipment manufacturers prior to being submitted to Consultant for review.
- .3 Submit letters from equipment suppliers certifying proper installation and start-up of piping systems and equipment as specified in Part 3 of this section.

1.02 Quality Assurance

- .1 Refrigerant piping systems are to be in accordance with CSA B52, Mechanical Refrigeration Code, and any applicable local Codes and Regulations.
- .2 Refrigerant piping installing contractor is to be certified by Technical Standards and Safety Authority (TSSA). Installing contractor is to install refrigerant piping in accordance with manufacturer's installation instructions and in accordance with local codes. Contractor is responsible for all regulatory approvals, if required. Upon completion of installation, documentation of refrigerant amount, test certificates and verification documentation, etc., is to be provided in a binder, in accordance with requirements of local authorities having jurisdiction.
- .3 Refrigerant piping and direct expansion refrigeration equipment must be installed by or under direct on site supervision of a licensed journeyman refrigeration mechanic.

2 Products

2.01 Pipe, Fittings and Joints

- .1 Type ACR hard drawn seamless copper refrigerant tubing to ASTM B280, factory degreased, dehydrated and capped or nitrogen filled and capped, complete with factory washed and bagged wrought copper soldering fittings to ASME B16.22, and brazed joints made with high melting point silver brazing alloy conforming to AWS Classification BcuP-5.

2.02 Piping Line Sets

- .1 Equal to Great Lakes Copper Inc. "EZ-Roll" soft annealed copper to ASTM B280, suitable for use with refrigerant involved, factory cleaned and capped, and with sizes and lengths as required.

2.03 General Re: Valves and Piping Specialties

- .1 Refrigerant valves and piping specialties specified below are to factory cleaned, degreased, and supplied to site with capped ends.

2.04 Shut-Off Valves

- .1 Ball Valves
 - .1 ¼ turn, CSA certified forged brass ball valves, each suitable for a maximum working pressure of 3445 kPa (500 psi) and complete with carbon filled Teflon ball seals, 2 O-ring stem seals, a gasketed seal cap, a flow direction arrow cast into body, a ball position indicator on stem, and extended copper tube connections to permit brazing the valve into line without disassembling valve.
 - .2 Acceptable manufacturers are:
 - .1 Mueller Industries Inc.;

- .2 Sporlan Valve Co.;
- .3 Superior Refrigeration Products/Sherwood.
- .2 Diaphragm Valves
 - .1 Forged brass, frost-proof, Type 1 Series, CSA certified packless diaphragm valves, each suitable for a 3445 kPa (500 psi) working pressure and complete with an O-ring to prevent moisture from entering diaphragm chamber, one phosphor bronze and 2 stainless steel diaphragms, and extended copper tube brazing connections.
 - .2 Acceptable manufacturers are:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.05 Check Valves

- .1 Straight through type for valves 6.4 mm to 16 mm (¼" to 5/8") diameter, globe type for valves 22 mm (7/8") diameter and larger, each complete with extended tubing for brazing connections, and as follows:
 - .1 straight through type check valves complete with a machined brass gasketed body, phosphor bronze spring, and neoprene seat;
 - .2 globe type check valves complete with a cast bronze body, forged brass cap, phosphor bronze spring, Teflon seat disc, and neoprene O-ring seal.
- .2 Acceptable manufacturers are:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.06 Piping Traps

- .1 Mueller Industries Inc. Style No. WE-554P brazing end copper "P" traps.
- .2 Acceptable manufacturers are:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.07 Pressure Vessel Relief Valves

- .1 Factory set pressure relief valves, straight through or angle type as required, each constructed in accordance with requirements of ANSI B9.1 and the ASME Code for Unfired Pressure Vessels, and each complete with a brass body, neoprene seat disc, and lead seal and locking wire.
- .2 Acceptable manufacturers are:
 - .1 Mueller Industries Inc.;

- .2 Sporlan Valve Co.;
- .3 Superior Refrigeration Products/Sherwood.

2.08 Refrigerant Liquid Moisture Indicators

- .1 Forged brass, triple sealed, CSA certified liquid moisture indicators, each suitable for a maximum working pressure of 3445 kPa (500 psi) and complete with a liquid indicator which shows "FULL" when system is fully charged with refrigerant and remains blank when there is a restriction or shortage of refrigerant in liquid line, a moisture indicator which changes colour from blue to pink when moisture is present in system, a plastic dust cover, and extended copper tube brazing connections.
- .2 Acceptable manufacturers are:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.09 Liquid Line Filter-Drier

- .1 Mueller Industries Inc. "Drymaster" CSA certified filter-driers, each suitable for a maximum 3445 kPa (500 psi) working pressure and complete with a combination of desiccants in a fluted briquette for drying, and a fluted briquette type filter.
- .2 Acceptable manufacturers are:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.10 Flexible Piping Connections

- .1 Senior Flexonics Canada "VIBRA-SORBERS" phosphor bronze construction, factory cleaned, dried, and sealed flexible piping connections with copper tube brazing ends.
- .2 Acceptable manufacturers are:
 - .1 Senior Flexonics Canada;
 - .2 The Metraflex Co.

2.11 Thermostatic Expansion Valves

- .1 Factory tested, balanced port design thermostatic expansion valves, with exact selection to suit the application and refrigerant used, each complete within a replaceable stainless steel diaphragm and welded element construction thermostatic element charged with hydraulic fluid, and removable inlet strainer.
- .2 Acceptable manufacturers are:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.12 Refrigerant Piping Roof Supports

- .1 Bases and blocks are to be UV resistant.
- .2 Clamps for refrigerant piping to be one (1) size larger than pipe to allow for expansion.
- .3 Clamps and screws to be galvanized.
- .4 Piping supports to be provided with two (2) year warranty.
- .5 Acceptable products are as follows:
 - .1 Pipe Ease – Quick Block – Polypropylene support block with rigid foam base;
 - .2 Mifab – CX/C Series – UV Resistant Recycled Rubber support with base;
 - .3 Nelson/Olsen – Quick Pipe Block – HDPE support with rigid foam base;
 - .4 Erico – Caddy Pyramid Series – Thermoplastic support with base.

3 Execution

3.01 Demolition

- .1 Perform required refrigerant piping system demolition work. Refer to demolition requirements specified in Section 20 05 00 – Selective Demolition for Mechanical.

3.02 Installation of Refrigerant Piping, Valves and Specialties

- .1 Provide required refrigerant piping. Piping is to be type ACR copper with wrought copper fittings. Install piping in accordance with requirements of reviewed refrigerant piping schematics referred to in Part 1 of this section.
- .2 Make refrigerant piping joints using a light coat of approved brazing flux applied to both pipe and fitting. Do not use acid flux. During brazing process, ensure pipe and fittings are kept full of nitrogen or carbon dioxide to prevent scale formation inside pipe and fitting.
- .3 Where shown or specified, use soft copper refrigerant piping line sets.
- .4 Provide shut-off valves to isolate each piece of equipment if shut-off valves are not supplied integral with equipment. Provide ball or diaphragm type shut-off valves inside building. Provide diaphragm shut-off valves outside building.
- .5 Provide a refrigerant charging valve for each system if such a valve is not supplied integral with equipment.
- .6 Provide refrigerant piping accessories shown and/or required and install in accordance with manufacturer's recommendations.
- .7 Provide required refrigerant.
- .8 Provide flexible connections at piping connections to roof mounted condensing units. Install in accordance with manufacturer's instructions. Refer to mechanical details on drawings for more requirements.
- .9 Provide expansion valves where shown and/or required, each matched to coil and installed in accordance with manufacturer's instructions.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for all products specified in this section except shop fabricated ductwork and fittings.
- .2 Include capacity, throw and terminal velocity, noise criteria, and pressure drops with grille and diffuser shop drawing/product data sheet submission.
- .3 With shop drawing/product data sheet submission, supply evidence that fire rated duct manufacturer is ULC listed to size requirements shows on drawings.
- .4 Submit duct leakage test data prior to ductwork being covered from view.
- .5 Submit manufacturer's colour chart(s) for all items for which a finish colour is to be selected.
- .6 Submit proper installation certification from fire rated duct manufacturer as specified in Part 3 of this section.
- .7 Submit a site inspection and start-up report from fan filter diffuser manufacturer's representative as specified in Part 3 of this section.
- .8 Supply and hand to Owner at Substantial Performance of the Work, a minimum of 10 identified (with tags) grille/diffuser volume control damper adjustment keys.
- .9 Supply reviewed copies of ventilator/curb assembly shop drawings or product data sheets to trade who will cut roof openings for ventilators, and ensure openings are properly sized and located.

1.02 Quality Assurance

- .1 Grilles and diffusers are to be tested and performance certified to ANSI/ASHRAE 70, Method of Testing the Performance of Air Outlets and Air Inlets.

2 Products

2.01 Galvanized Steel Ductwork

- .1 Galvanized steel sheet is to be hot dipped in accordance with requirements of ASTM A653. G60 galvanizing for bare uncovered duct to be finish painted. G90 for all other galvanizing.
- .2 Rectangular
 - .1 Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.
- .3 Round
 - .1 Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings and couplings.
- .4 Flat Oval
 - .1 Factory machine fabricated, single wall, 4-ply spiral lock seam duct, fittings and couplings.

2.02 Flexible Metallic Ductwork

- .1 Bare
 - .1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-UN", ULC S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, and supplied in 3 m (10') lengths.

- 2 Insulated
 - .1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-I", ULC S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, supplied in 3 m (10') lengths and factory covered with 40 mm (1-1/2") thick, 12 kg/m³ (0.75 lb/ft³) density fibreglass insulation with a vinyl jacket meeting 25/50 flame spread and smoke developed requirements tested in accordance with CAN/ULC S102.

2.03 Flexible Fabric Ductwork

- .1 Equal to DuctSox Corp. round fabric air duct, 25/50 flame spread/smoke developed rated when tested in accordance with CAN/ULC S102, white or coloured (to manufacturer's standards), and complete with 3 x 1 tension cable suspension system.

2.04 Flexible Connection Material

- .1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber. Acceptable products are:
 - .1 Duro Dyne Canada Inc. "DUROLON";
 - .2 Dyn Air Inc. "HYPALON".
- .2 Waterproof, flameproof, high temperature flexible connection material meeting requirements of NFPA 90A, consisting of a woven glass fibre fabric coated on both sides with silicone rubber. Acceptable products are:
 - .1 Duro-Dyne Canada Inc. "THERMAFAB";
 - .2 Dyn Air Inc. "SILICON HI-T".

2.05 Metal Duct System Joint Sealant

- .1 ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 tested maximum flame spread rating of 5 and smoke developed rating of 0.
- .2 Acceptable manufacturers are:
 - .1 Johns Manville;
 - .2 Manson Insulation;
 - .3 Knauf Insulation.

2.06 Acoustic Lining

- .1 Minimum 25 mm (1") thick acoustic lining material meeting 25/50 flame spread and smoke developed ratings tested in accordance with CAN/ULC S102, meeting NFPA 90A, ASTM C1071, and ASTM G21 requirements, not supporting microbial growth, flexible for round ducts, board type for rectangular ducts, consisting of a bonded fiberglass mat coated on inside (airside) face with a black fire-resistant coating.
- .2 Acceptable manufacturers are:
 - .1 Johns Manville;
 - .2 Manson Insulation;
 - .3 Knauf Insulation.

2.07 Kitchen Exhaust Duct Expansion Joint

- .1 Hyspan Precision Products Inc. Series 2500 flanged, carbon steel, rectangular expansion joints sized to suit ductwork.

2.08 Uninsulated Kitchen Grease Exhaust Duct

- .1 Minimum #16 gauge black sheet steel liquid-tight ductwork with welded joints or listed in accordance with CAN/ULC S662.
- .2 Grease-tight access doors in accordance with requirements of NFPA 96, constructed of same material as duct and as large as possible, up to 600 mm (24") in any dimension, located in the sides of the duct for ease of inspection and cleaning at each change in duct direction, at not less than 3 m (10') in straight duct including risers, and not less than 40 mm (1-1/2") from bottom of duct.

2.09 Factory Insulated Round Kitchen Grease Exhaust Duct

- .1 Equal to Selkirk ZeroClear kitchen exhaust duct, 2 hour fire rated to UL 2221, constructed, listed and labelled to UL/ULC 1978, and meeting requirements of NFPA 96. Duct is constructed of a type 304 stainless steel inner liner, 75 mm (3") of high temperature fibre insulation, and a stainless steel outer jacket, and is complete with all required fittings and accessories, including access and cleanout fittings where required.

2.10 Factory Insulated Rectangular/Square Kitchen Grease Exhaust Duct

- .1 Equal to DuraSystems "DuraDuct KEX" kitchen exhaust duct, 2 hour rated kitchen exhaust listed and labelled to CAN/ULC S144, and meeting requirements of NFPA 96. Duct is constructed of minimum #16 gauge black sheet steel inner liner, high temperature fibre insulation and a minimum #24 gauge galvanized steel outer jacket, and complete with required fittings and accessories, including access and cleanout fittings where required. Factory-fabricated grease duct assembly is to not require additional wraps or enclosures to achieve required fire resistance rating.

2.11 Factory Insulated Fire Rated Ductwork

- .1 Equal to DuraSystems Barriers Inc. "DuraDuct HP" or "DuraDuct GNX" duct, 2 hour fire rated, constructed, ULC listed and labelled for fire rated ventilation applications. Duct is constructed of a galvanized steel inner liner, a galvanized steel outer jacket, and all required fittings and accessories, including support hardware.

2.12 Casing And Plenum Material and Accessories

- .1 Unless otherwise specified, casing and plenum material is to be same as connecting duct material.
- .2 Accessories such as access doors and drain pans are to be constructed of same material as casing and plenum and are to be in accordance with Chapter 6 of SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.13 Acoustic Plenum Panels

- .1 Vibro-Acoustics Ltd. type "AP", 100 mm (4") thick panels with acoustic media meeting NFPA 90A requirements sandwiched between minimum #24 gauge galvanized sheet steel, with airside face perforated, access doors where shown, and with acoustic performance as follows:

Octave Bands, (Hz)	125	250	500	1000	2000	4000
Transmission Loss	21	28	39	50	53	56
Absorption Coefficient	0.7	0.9	.99	.99	0.9	0.9

- .2 Acoustic plenum media factory encapsulated in sealed DuPont "Tedlar" polyvinyl fluoride film to ensure no media enters the airstream.
- .3 Acceptable manufacturers are:
 - .1 Vibro-Acoustics Ltd.;

- .2 Kinetics Noise Control Inc.;
- .3 Carrier Corp. – Racan;
- .4 Haakon Industries;
- .5 Price Industries Inc.

2.14 Plenum Access Doors

- .1 Factory fabricated, double wall insulated access doors, sized as indicated on drawings, and constructed of same material as connecting ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit operating pressure of the system.

2.15 Round to Rectangular Duct Connections

- .1 Equal to Flexmaster Canada Ltd. galvanized steel, flared, flanged or notched "Spin-On" round duct take-off collars with locking dampers in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.16 Splitter Dampers

- .1 Minimum #20 gauge damper blade constructed of same material as duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to DynAir Inc. #Q-50 "DYN-A-QUAD S-S" quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.

2.17 Air Turning Vanes

- .1 For square elbows, multiple-radius turning vanes interconnected with bars, adequately reinforced to suit pressure and velocity of system, constructed of same material as duct they are associated with, and in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 For short branch ducts at grille and diffuser connections, air extractor type each equipped with a matching bottom operated 90° opposed blade volume control damper, constructed of same material as duct it is associated with and in accordance with requirements and details in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.18 Manual Balancing (Volume) Dampers

- .1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of same material as connecting ductwork unless otherwise specified, each designed to maintain internal free area of connecting duct, and each complete with:
 - .1 hexagonal or square shaft extension through frame;
 - .2 non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers;
 - .3 blade stops for single blade dampers, designed to prevent blade from moving more than 90°;
 - .4 linkage for multiple blade dampers;
 - .5 locking hand quadrant damper operator with, for insulated ducts 50 mm (2") standoff mounting.
- .2 Rectangular Dampers: Nailor Industries Inc. 1800 Series, maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.
- .3 Round Dampers: Nailor Industries Inc. Model 1890, maximum 600 mm (24") diameter, equipped with a minimum 200 mm (8") deep frame, and blade stiffeners where required.
- .4 Multiple Rectangular Damper Section Assembly: Rectangular assembly supplied with the dampers or site constructed, of same material as damper and designed for tight and secure mounting of individual dampers.

- .5 Acceptable manufacturers are:
 - .1 Nailor Industries Inc.;
 - .2 T.A. Morrison & Co. Inc. "TAMCO";
 - .3 NCA Manufacturing Ltd.;
 - .4 Greenheck Fan Corp.;
 - .5 Ruskin Co.

2.19 Backdraft Dampers

- .1 Nailor Industries Model 1370CB counterbalanced backdraft dampers, vertical or horizontal mounting, 50 mm (2") wide, sized as shown and complete with:
 - .1 extruded 6063-T5 aluminum frame, 2.3 mm (0.090") nominal wall thickness, with mitred corners;
 - .2 extruded 6063-T5 aluminum blades, 1.3 mm (0.050") nominal wall thickness on 92 mm (3-5/8") centres, and with extruded PVC blade seals;
 - .3 corrosion-resistant synthetic bearings;
 - .4 adjustable plated steel counterweights mounted internally in the airstream;
 - .5 concealed blade linkage located out of the airstream.
- .2 Acceptable manufacturers are:
 - .1 Nailor Industries Inc.;
 - .2 T.A. Morrison & Co. Inc. "TAMCO";
 - .3 NCA Manufacturing Ltd.;
 - .4 Greenheck Fan Corp.;
 - .5 Ruskin Co.

2.20 Fusible Link Dampers

- .1 Curtain blade type, dynamic, galvanized steel (unless otherwise specified) fusible link dampers, ULC classified to CAN/ULC S112 and in accordance with NFPA 90A requirements, factory tested for closure under airflow, 1-1/2 hour or 3 hour rated as required, and complete with a constant force type 301 stainless steel closure spring, a blade lock assembly, a steel sleeve, retaining angles, and, unless otherwise specified, a 74°C (165°F) rated standard fusible link.
- .2 Fusible link dampers are to be Type "B" or Type "C" (as required) with folded curtain blade out of air stream except where damper size or location requires use of type "A" dampers with curtain blade in air stream.
- .3 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.
- .4 Acceptable manufacturers are:
 - .1 Nailor Industries Inc.;
 - .2 Greenheck Fan Corp.;
 - .3 NCA Manufacturing Ltd.;

- .4 Ruskin Co.;
- .5 Price Industries (E.H. Price).

2.21 Combination Fire/Smoke Dampers

- .1 Nailor Industries Series 1220, ULC listed to CAN/ULC S112 and CAN/ULC S112.1, meeting requirements of NFPA 80, 90A, 92, 101 and 105, consisting of type A, B, or C fusible link fire dampers as required and a fail-safe, opposed blade, normally closed, motor operated smoke damper complete with factory installed and tested 120 V electric actuator.
- .2 ULC 1-1/2 hour fire rated and ULC Class I leakage rated for smoke, and equipped with a 74°C (165°F) ULC classified fusible link that will cause damper to close and lock independent of actuator when duct temperature reaches maximum temperature of damper assembly.
- .3 Supply damper with factory installed sleeves of minimum 400 mm (16") length, field verified by contractor dependent on wall thickness. Caulk sleeves to ULC requirements and constructed of 20 gauge for sizes up to 2.1 m (84") wide and 18 gauge for sizes greater than 2.1 m (84") wide.
- .4 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.
- .5 Acceptable manufacturers are:
 - .1 Nailor Industries Inc.;
 - .2 Greenheck Fan Corp.;
 - .3 NCA Manufacturing Ltd.;
 - .4 Ruskin Co.;
 - .5 Price Industries (E.H. Price).

2.22 Smoke Dampers

- .1 Multi-blade type, fail-safe, dynamic, galvanized steel (unless otherwise specified) smoke dampers, ULC classified to CAN/ULC S112.1, ULC Class I leakage rated for smoke, meeting requirements of NFPA 90A, 92, 101 and 105, normally closed, low pressure drop design, dynamically tested, each complete with jamb and blade seals, linkage concealed in the frame, a steel sleeve to suit the opening, and an electric actuator to automatically close damper upon receiving an external signal, and to automatically open damper when system is reset.
- .2 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.
- .3 Acceptable manufacturers are:
 - .1 Nailor Industries Inc.;
 - .2 Greenheck Fan Corp.;
 - .3 NCA Manufacturing Ltd.;
 - .4 Ruskin Co.;
 - .5 Price Industries (E.H. Price).

2.23 Roof Duct Supports

- .1 Equal to PHP Systems Design Model PHP-D adjustable duct support assemblies sized to suit duct size, each assembly complete with injection moulded recycled plastic and carbon black bases and tubular hot dip galvanized steel framing.

2.24 Duct Access Doors

- .1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, with sizes suitable in all respects for purpose for which they are provided, and, unless otherwise specified, constructed of same material as duct they are associated with.

2.25 Ductwork Drain Points

- .1 Equal to Ductmate Canada Ltd. "Moisture Drain", 20 mm ($\frac{3}{4}$ " diameter moisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut and cap.

2.26 Instrument Test Ports

- .1 Equal to Duro-Dyne of Canada Ltd. #IP1 or #IP2 (to suit insulation thickness where applicable) gasketed, leakproof instrument test ports for round or rectangular ducts as required, each complete with a neoprene expansion plug and a plug securing chain.

2.27 Wire Mesh (Birdscreen)

- .1 Heavy-gauge galvanized steel or aluminum mesh, 12 mm x 12 mm ($\frac{1}{2}$ " x $\frac{1}{2}$ ") secured in a rigid galvanized steel or aluminum framework, sized as indicated on drawings, and constructed so as to be removable.

2.28 Louvres

- .1 Price Industries Inc. DE439 or DE635, 100 mm (4") or 150 mm (6") deep (to suit wall thickness) factory assembled stationary, drainable, louvres sized as indicated on drawings, each AMCA water penetration and air performance certified, constructed of welded, extruded, alloy 6063-T5 aluminum with drainable blades, mounting and securing hardware to suit the application, and 12 mm ($\frac{1}{2}$ " mesh aluminum birdscreen in an aluminum frame.
- .2 Acoustical Louvres: Price Industries Inc. Model QA1245 300 mm (12") deep, welded, extruded alloy 3003-H14 aluminum, storm-proof, stationary, drainable acoustical louvers, AMCA water penetration and air performance certified, with high density mineral wool acoustic media secured to blades and protected by perforated aluminum, sound ratings in accordance with ASTM E90 and ASTM E413, and mounting and securing facilities as required.
- .3 Louvres are to be factory finished with a finish equal to PPG Industries "Duramar" fluoropolymer powder coating over primer with colour as selected from manufacturer's standard colour range.
- .4 Acceptable manufacturers are:
 - .1 Price Industries Inc.;
 - .2 The Airlite Co. LLC;
 - .3 Construction Specialties;
 - .4 Nailor Industries Inc.;
 - .5 Ventex
 - .6 Ruskin

2.29 Louvre Blank-Off Panels

- .1 Insulated, framed, sandwich construction panels consisting of 40 mm (1- $\frac{1}{2}$ ") thick rigid insulation (meeting NFPA 90A requirements) between minimum #20 gauge galvanized sheet steel with exterior face of panels finished to match finish of exterior wall louvres.

2.30 Brick And Block Vents

- .1 Equal to Price Industries Inc. vents constructed of 6063-T5 alloy extruded aluminum, sized as shown, complete with stainless steel fasteners, aluminum rod vertical supports on minimum 300 mm (12") centres, #2 mesh fixed aluminum screen, and all required accessories to suit the application.
- .2 Vent(s) to be factory finished with a finish equal to a baked "Kynar 500-XL" colour coat and a clear coat over cleaned and primed metal with colour as selected from manufacturer's standard colour range.
- .3 Acceptable manufacturers are:
 - .1 Price Industries Inc.;
 - .2 The Airlite Co. LLC;
 - .3 Construction Specialities;
 - .4 Nailor Industries Inc.;
 - .5 Ventex
 - .6 Ruskin

2.31 Fire Stop Flaps and Thermal Blanket Material

- .1 Rectangular or round, ULC listed and labelled, blade type galvanized steel fire stop flaps in accordance with CAN/ULC S112, Standard Methods of Fire Test of Fire-Damper Assemblies and CAN/ULC S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies, each complete with #22 gauge G60 galvanized steel blade(s) and frame, a 74°C (165°F) fusible link, and, for dampers 300 mm (12") and larger, ceramic fibre insulation on both sides of the blades.
- .2 Ceramic fibre material in accordance with 25/50 flame spread/smoke developed ratings when tested to CAN/ULC S102 and of a thickness to suit required fire rating.

2.32 Grilles and Diffusers

- .1 Grilles and diffusers of type, size, capacity, finish, and arrangement as shown on drawings and in accordance with drawing schedule, each equipped with all required mounting and connection accessories to suit mounting location and application.
- .2 Acceptable manufacturers are:
 - .1 Price Industries Inc.;
 - .2 Carnes;
 - .3 Krueger Division of Air System Components Inc.;
 - .4 Titus;
 - .5 Nailor Industries Inc.;
 - .6 Metalaire;

2.33 Louvred Penthouse Type Ventilators

- .1 Low silhouette, rectangular, roof mounting louvred penthouse type hoods in accordance with drawing schedule, each constructed of aluminium, supplied in knock-down form for site assembly, and each complete with:
 - .1 extruded aluminium, welded storm-proof louver blades with mitred corners and stainless steel securing screws;

- .2 removable cover for internal access, lined with glass fibre insulation material and equipped with stainless steel fasteners;
 - .3 12 mm x 12 mm (½" x ½") aluminium mesh birdscreen;
 - .4 welded aluminium, minimum 300 mm (12") high insulated roof mounting curb with damper tray and curb seal;
 - .5 aluminium backdraft damper supplied loose, for site installation in roof curb damper tray;
 - .6 non-corrosive motorized damper supplied loose for site installation in roof curb damper tray, equal to T. A. Morrison TAMCO Series 9000 insulated damper with linkage, end switch, and a Belimo or equal motor with voltage to suit site control voltage requirements;
- .2 Acceptable manufacturers are:
- .1 Greenheck Fan Corp.;
 - .2 Twin City Fan and Blower;
 - .3 PennBarry.

3 Execution

3.01 Cleanliness Requirements for Handling and Installation of Ductwork

- .1 Handle and install ductwork in accordance with CSA Z317.2, Special Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Healthcare Facilities and SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.
- .2 Handle and install ductwork in accordance with SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.

3.02 Fabrication and Installation of Galvanized Steel Ductwork

- .1 Provide required ductwork, rectangular, round and/or flat oval. Where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.
- .2 It is to be understood that all duct dimensions shown on drawings are clear internal dimensions.
- .3 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit duct pressure class designation of minimum 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so ductwork does not "drum". Flat surfaces of rectangular ductwork are to be cross-broken. Duct system sealing is to meet ANSI/SMACNA Seal Class A requirements.
- .4 Variable air volume ductwork from supply fans to boxes is as above but rectangular duct take-offs are double side straight taper type with a take-off length equal to 0.5 times the branch duct width but minimum 150 mm (6") length, and double taper side is to have an included angle of minimum 60°.
- .5 Confirm routing of all ductwork at site and site measure ductwork prior to fabrication. Duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by Consultant. Duct routing and/or dimension revisions to suit conditions at site are not grounds for a claim for an extra cost.
- .6 Refer to structural drawings. Where ductwork is to be run within or through open web steel joists, ductwork shown on mechanical drawings is schematic only and is to be altered as required to suit steel joist configuration, spacing, panel points, and cross-bridging at no additional cost.
- .7 Wherever ductwork is required at locations where sprayed fireproofing is applied to building construction, install ductwork only after fireproofing work is complete and do not compromise fire rating of sprayed fireproofing.

- .8 Install (but do not connect) duct system mounted automatic control components supplied as part of the automatic control work.
- .9 Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.
- .10 Flange connect ductwork to hot water reheat coils in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Coils will be suspended independent of connecting ductwork as part of the heat transfer work.
- .11 Support horizontal rectangular ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with, unless otherwise specified, galvanized steel channels, and galvanized steel hanger rods for exposed ducts and concealed ducts wider than 500 mm (20"). Support hardware constructed of same material as duct for metal duct, and, unless otherwise specified, type 316 stainless steel for non-metal duct. Supports for "heavy" duct such as cementitious core duct is to be suitable in all respects for the application and approved by Consultant.
- .12 Support round and flat oval ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at top of duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If duct is insulated, size strap to suit diameter of insulated duct. Unless otherwise specified, duct support hardware for metal duct is constructed of same material as duct, and for non-metal duct, type 316 stainless steel.
- .13 Where flanged duct joints are used, do not locate joints in wall or slab openings, or immediately at wall or slab openings. Do not use flanged joints for exposed uninsulated ducts in finished areas.
- .14 Where watertight horizontal ductwork is required, construct ducts without bottom longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer. Slope horizontal duct to hoods, risers, or drain points. Provide drain points. Provide watertight ductwork for:
 - .1 ductwork outside building or otherwise exposed to the elements;
 - .2 shower exhaust ducts from grilles to duct main or riser;
 - .3 fresh air intakes;
 - .4 wherever else shown.
- .15 Leakage Testing:
 - .1 Ductwork leakage is not to exceed following:
 - .1 ductwork to 2" W.C. Class, 1% of total air quantity handled by respective fans;
 - .2 ductwork exceeding 2" W.C. Class, 2% of total air quantity handled by respective fans.
 - .2 Leakage testing is to be performed by the Testing, Adjusting and Balancing (TAB) agency in accordance with SMACNA HVAC Air Duct Leakage Test Manual and is to be witnessed by Consultant.
 - .3 Be responsible for following:
 - .1 preparing duct systems for leakage testing prior to installation of external insulation including capping duct runouts and provision of final tap-in for test equipment;
 - .2 schedule testing with TAB agency in advance, be present for all testing and ensure notice is given to Consultant so they may witness testing;
 - .3 resealing and/or replacement of defective ductwork;
 - .4 bearing all costs associated with retesting ductwork which has failed to pass leakage testing.
- .16 Seal all ductwork in accordance with SMACNA Seal Class "A", except for round duct with self-sealing gasketed fittings and couplings which does not require site applied sealant. Apply sealants by brush or gun to cleaned metal surfaces. Where bare

ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.

- .17 Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.
- .18 Clean exterior exposed (uninsulated) ducts and coat with a heavy full coverage of Bakor #410-02 black metal paint.
- .19 Where dissimilar metal ducts are to be connected, isolate ducts by means of flexible duct connection material.
- .20 Round exposed ductwork in Gymnasium is to be 2 metal gauges heavier than standard metal gauge for same size duct, and duct hangers are to be pairs of 9.5 mm ($\frac{3}{8}$ ") diameter hanger rods secured to 40 mm (1- $\frac{1}{2}$ ") wide #12 gauge galvanized steel split clamps around full circumference of duct at maximum 1.8 m (72") centres. Provide double nuts and lock washers on each hanger rod above and below each clamp.

3.03 Installation of Fabric Ductwork

- .1 Provide fabric ductwork.
- .2 Secure duct from structure by means of tension cable and suspension components supplied with ductwork.
- .3 Install tension cable and suspension components in accordance with duct manufacturer's instructions.
- .4 Provide metal duct connection collars as required.
- .5 Start-up fabric duct system in accordance with manufacturer's instructions.
- .6 Do not penetrate fire barriers with fabric duct.

3.04 Installation of Flexible Ductwork

- .1 Provide maximum 3 m (10') long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles and diffusers. Do not install flexible ductwork through walls, even if shown on drawings.
- .2 At rectangular galvanized steel duct, accurately cut holes and provide flanged or "Spin-in" round flexible duct connection collars. Seal joints with duct sealer.
- .3 Install flexible ducts as straight as possible and support in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, and secure at each end with nylon or stainless steel gear type clamps, and seal joints. Provide long radius duct bends where they are required.
- .4 Do not penetrate fire barriers with flexible duct.

3.05 Installation of Acoustic Lining

- .1 Provide acoustic lining in ductwork in locations as follows:
 - .1 wherever shown and/or specified on drawings;
 - .2 supply ductwork downstream of air terminal boxes for a distance of 2.4 m (8') measured along duct and outward from box in all directions;
 - .3 all transfer air ducts.
- .2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel in accordance with detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

3.06 Installation of Fire Rated Ductwork

- .1 Provide 2 hour fire rated ductwork.
- .2 Install ductwork in strict accordance with duct manufacturer's instructions using support hardware supplied with duct.
- .3 When installation is complete, arrange, and pay for duct manufacturer to visit site and examine duct installation. Make any revisions requested by manufacturer, and when manufacturer is satisfied with installation, obtain and submit a letter certifying proper installation in accordance with ULC requirements.

3.07 Installation of Sheet Steel Kitchen Grease Exhaust Ductwork

- .1 Provide welded sheet steel kitchen grease exhaust ductwork from exhaust hood(s) to roof mounted exhaust fans, all in accordance with requirements of NFPA 96. Construct ductwork watertight with continuous externally welded seams and joints, cleanouts, duct expansion provisions, riser residue traps, etc.
- .2 Clean and prime coat ground welds in black steel ducts.
- .3 Support ductwork at not greater than 1.5 m (5') intervals and ensure fasteners at hangers do not penetrate duct. Install without forming dips, sags or traps where grease residue might collect, and locate access door/cleanouts for ease of maintenance.
- .4 Slope horizontal ductwork 25 mm per 300 mm (1" per foot) back to exhaust hood.

3.08 Installation of Casings and Plenums

- .1 Provide required shop or site fabricated casings and plenums. Unless otherwise specified or shown, construct casings and plenums of same material as connecting duct system.
- .2 Construct and install casings and plenums in accordance with Chapter 6 of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit systems' pressure classification. Ensure plenums and casings secured to building structure are gasketed air-tight and equipped with angle reinforcing.
- .3 Provide drain pans with accessible trapped drains for fresh air intake plenums, and wherever else shown.
- .4 In addition to SMACNA duct construction standards specified above, casings and plenums are to be constructed and installed to meet seismic requirements of British Columbia Building Code and ANSI/SMACNA - The Seismic Restraint Manual: Guidelines for Mechanical Systems.

3.09 Installation of Acoustic Panels

- .1 Provide acoustic panels for plenums. Integrate acoustic plenums with standard casings and plenums. Install acoustic panels in strict accordance with manufacturer's instructions. Seal panels with acoustic caulking where pipes, ducts or conduit penetrate and make air and watertight.
- .2 Provide floor to ceiling high acoustic plenums where shown, each complete with required framing, including framing for access doors and other openings, each structurally designed to resist excessive deflection or bowing, constructed to be air-tight when subjected to a pressure differential of 2.48 kPa (0.36 psi), and designed so any one panel can be removed without dismantling entire plenum.
- .3 Provide acoustic type access doors where shown, and provide acoustic caulking at all locations where acoustic plenums abutt building walls or slabs, and at all points where pipe, ducts or conduit penetrate acoustic panels.
- .4 In addition to SMACNA duct construction standards specified above, acoustic plenums are to be constructed and installed to meet seismic requirements of British Columbia Building Code and ANSI/SMACNA, The Seismic Restraint Manual: Guidelines for Mechanical Systems.

3.10 Installation of Casing and Plenum Access Doors

- .1 Provide access doors into all site or shop fabricated casings and plenums requiring access, and wherever shown.
- .2 Construct access doors to open in or out to suit positive and negative pressures of system.
- .3 Provide pitot tube openings in access doors where required for system air quantity balancing purposes.
- .4 Provide suitably sized, engraved, red-white laminated Lamacoid warning nameplates on access doors into casings and plenums where equipment is located, i.e. fans.

3.11 Installation of Round to Rectangular Duct Connections

- .1 Cut round holes in rectangular ducts and provide round to rectangular lock-in fittings with dampers for connection of flexible round ductwork.

3.12 Installation of Splitter Dampers

- .1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified on drawings. Install splitter dampers so they cannot vibrate and rattle and so damper operation mechanisms are in an easily accessible and operable location. Ensure operators for dampers in insulated ducts are equipped with stand-off mounting brackets.

3.13 Installation of Turning Vanes

- .1 Provide turning vanes in ductwork elbows where shown on drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 Provide volume extractor type turning vanes in short branch supply duct connections off mains to grilles and diffusers where shown and/or specified.

3.14 Installation of Manual Balancing (Volume) Dampers

- .1 Provide manual balancing dampers as required to provide a fully balanced system, including but not limited to in all open end ductwork, in all duct mains, and wherever else shown and/or specified.
- .2 Install dampers so operating mechanism is accessible and positioned for easy operation, and so dampers cannot move or rattle. Ensure operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.
- .3 Where a duct for which a balancing damper is required has dimensions larger than dimensions of maximum size volume damper available, provide multiple dampers bolted together in a properly sized assembly, or bolted to a heavy-gauge black structural steel angle or channel framework which is properly sized. Seal to prevent air by-pass, and provide connecting linkage.
- .4 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing 5 additional dampers at no additional cost.

3.15 Installation of Backdraft Dampers

- .1 Provide backdraft dampers.
- .2 Install and secure dampers so they cannot move or rattle.

3.16 Installation of Fusible Link Dampers

- .1 Provide fusible link dampers. Ensure damper rating (1-½ or 3 hr.) is suitable for fire barrier it is associated with.
- .2 Install dampers with retaining angles on all 4 sides of sleeve on both sides of damper and connect with ductwork in accordance with damper manufacturer's instructions and details, and Code requirements.

- .3 Provide expansion clearance between damper or damper sleeve and opening in which damper is required. Ensure openings are properly sized and located, and all voids between damper sleeve and opening are properly sealed to maintain rating of fire barrier.
- .4 Where size of fire barrier opening requires use of a sectionalized fire damper assembly, provide multiple fusible link dampers (sized to CAN/ULC S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.

3.17 Installation of Combination Fire/Smoke Dampers

- .1 Provide combination fire/smoke dampers. Install dampers with retaining angles on all 4 sides of each side of damper, and, where required, connect with ductwork, all in accordance with damper manufacturer's instructions and details, and Code requirements.
- .2 Coordinate damper installation with electrical work where electrical connections to damper actuators are specified.

3.18 Installation of Smoke Dampers

- .1 Provide smoke dampers. Install dampers with retaining angles on all 4 sides of sleeve on both sides of damper and connect with ductwork in accordance with damper manufacturer's instructions and details, and Code requirements.
- .2 Coordinate damper installation with electrical work where electrical connections to damper actuators are specified.

3.19 Installation of Flexible Connection Material

- .1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums, and/or easings connect to fans, and wherever else shown or specified.
- .2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of flexible fabric and to fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure connections to flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.

3.20 Installation of Roof Mounted Duct Supports

- .1 Supply supports for roof mounted ductwork.
- .2 For new roof construction, hand adjustable structural supports to roofing trade on roof for installation and flashing into roof construction as part of roofing work. Accurately mark exact locations and spacing of structural supports and supervise installation. Provide properly sized hot dip galvanized structural steel angles between structural supports and secure in place on support studs. Support ductwork on the angles and provide galvanized steel banding to secure ducts to the angles.
- .3 For installations on existing roof, accurately mark location and spacing of roof support assemblies. At each plastic base location, carefully scrape away loose roof ballast (gravel) and all other debris and dirt. Prime existing membrane with a primer which is compatible with existing roofing components. Set bases in adhesive in accordance with manufacturer's installation instructions. Scrape loose ballast back around and on bases. Install framing, and install ductwork on the cross-members. Secure ductwork to cross-members with galvanized steel banding.

3.21 Installation of Duct Access Doors

- .1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Install in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure doors are properly located for damper maintenance.
- .3 When requested, submit a sample of proposed duct access doors for review.
- .4 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce ductwork to suit access door installed.

3.22 Installation of Instruments Test Ports

- .1 Provide instrument test ports in all main ducts at connections to fans, plenums or casings, in all larger branch duct connections to mains, and wherever else required for proper air quantity balancing and testing.
- .2 Locate test ports where recommended by personnel performing air quantity testing and balancing work.

3.23 Installation of Wire Mesh (Birdscreen)

- .1 Provide framed, removable wire mesh panels over openings in ducts and/or walls where shown and/or specified on drawings. Rigidly secure in place but ensure panels are removable.
- .2 Provide wire mesh panels for open-end return air ducts in ceiling spaces whether shown on drawings or not.

3.24 Installation of Louvres

- .1 Provide louvres for wall openings.
- .2 Install louvre assemblies and secure in place in accordance with manufacturer's instructions and details.
- .3 Confirm exact louvre sizes and finish prior to ordering.
- .4 Intake outdoor air louvres to be at a minimum of 3m/10ft distance of washroom exhausts, gas fired equipment flues or other contaminants to prevent cross contamination.

3.25 Installation of Louvre Blank-Off Panels

- .1 Provide blank-off panels for inactive portions of exterior wall louvres.
- .2 Secure panels in place with non-ferrous hardware so they cannot move or rattle, yet are easily removable.
- .3 Confirm exact finish of panels prior to fabrication.

3.26 Installation of Brick and Block Vents

- .1 Supply brick or block vents for installation in exterior walls.
- .2 Hand assemblies to masonry trade for installation.
- .3 Accurately mark exact locations and coordinate installation.

3.27 Installation of Fire Stop Flaps and Thermal Blankets

- .1 Provide fire stop flaps in duct connection necks of grilles and diffusers installed in ULC fire rated suspended ceiling systems where shown on drawings.
- .2 Provide thermal blanket material to completely cover grille and/or diffuser pans above suspended ULC fire rated ceilings. Cut, install, and secure in place in accordance with manufacturer's instructions and ULC requirements.

3.28 Installation of Grilles and Diffusers

- .1 Provide grilles and diffusers. Wherever possible, grilles and diffusers are to be product of same manufacturer.
- .2 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .3 Exactly locate grilles and diffusers to conform to final architectural reflected ceiling plans and detailed wall elevations, and to conform to final lighting arrangement, ceiling layout, ornamental and other wall treatment.

- .4 Equip supply diffusers having a basic 4-way or all round air pattern for operation in 1-, 2-, or 3-way pattern where indicated on drawings.
- .5 Provide sheet metal plenums, constructed of same material as connecting duct, for linear grilles and/or diffusers where shown. Construct and install plenums in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible. Where individual sections of linear grilles or diffusers are not equipped with a volume control device, equip duct connection collar(s) with volume control device(s).
- .6 Where linear type diffusers/grilles are installed in suspended T-bar ceilings, clip diffusers/grilles in place using clip supplied by diffuser/grille manufacturer.
- .7 Confirm grille and diffuser finishes prior to ordering.

3.29 Supply of Door Grilles

- .1 Supply door grilles as shown and scheduled.
- .2 Hand grilles to appropriate trade at site for installation.

3.30 Installation of Roof Mounted Gravity Ventilators

- .1 Provide roof mounted gravity ventilators.
- .2 Supply a roof mounting curb with each ventilator and hand curbs to roofing trade on roof for mounting and flashing into roof construction as part of the roofing work. Site assemble gravity ventilators as required, and secure in place on curbs.
- .3 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 – Seismic Controls for Mechanical Systems.
- .4 Install dampers in curb damper tray and secure in place.

3.31 Duct System Protection, Cleaning and Start-Up

- .1 Temporarily cover all open ends of ducts during construction.
- .2 Remove all dirt and foreign matter from entire duct systems and clean duct system terminals and interior of air handling units prior to operating fans.
- .3 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.
- .4 Provide cheesecloth over duct system inlets and outlets and run system for 24 hours, after which remove cheesecloth and construction filters, and install new permanent filters.
- .5 Include all labour for a complete site walk-through with testing and balancing personnel following route of all duct systems to be tested, adjusted and balanced for the purpose of confirming proper position and attitude of dampers, location of pitot tube openings, and any other work affecting testing and balancing procedures. Perform corrective work required as a result of this walk-through.

End of Section

1 General

1.01 Submittals

- .1 Submit shop product data sheets for silencers. Include all construction, acoustic and aerodynamic performance data, and details with submission. Acoustical data is to demonstrate that duct systems with silencers will reduce mechanical fan system noise to required levels in occupied spaces.
- .2 Submit manufacturer's test data to indicate results of factory tests on the silencers prior to shipment.
- .3 Submit a copy of the silencer manufacturer's National Voluntary Laboratory Accreditation Program (NVLAP) accreditation certificate for ASTM E477 test standards.
- .4 Submit an installation certification letter from silencer manufacturer as specified in Part 3 of this section.

1.02 Quality Assurance

- .1 Silencer performance must be substantiated by laboratory testing in a duct-to-reverberant room test facility according to ASTM E477, Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Material and Prefabricated Silencers.
- .2 Silencer acoustic media and any lining/wrapping material must have a maximum flame spread rating of 25 and a smoke developed rating of 50 when tested in accordance with CAN/ULC S102, Surface Burning Characteristics of Building Materials, and Accessories.
- .3 Acceptable silencer manufacturers are:
 - .1 Vibro-Acoustics Ltd.;
 - .2 Kinetics Noise Control Vibron Products Group;
 - .3 Price Industries Inc.

2 Products

2.01 General Re: Silencers

- .1 Silencers are to be factory fabricated by same manufacturer and are to be in accordance with drawing schedule, and tested in accordance with ASTM E477 through National Voluntary Laboratory Accreditation Program (NVLAP) with valid accreditation certificate.
- .2 Silencer inlet and outlet dimensions are to be equal to duct sizes shown on drawings. Unless otherwise shown or specified, transitions will not be permitted.
- .3 Silencers are to be constructed in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible, to suit duct system pressure and velocity classification. Unless otherwise specified, casing seams and joints are to be lock-formed and sealed or stitch welded and sealed, and silencers are to be constructed so as not to fail when subjected to an internal static pressure of 3.9 kPa (8" wg).
- .4 Perforated steel is to be adequately stiffened to ensure flatness and form, and welds are to be shop painted with zinc rich paint.
- .5 Galvanized steel is to be in accordance with ASTM A653.

2.02 Outer Casing Materials

- .1 Rectangular Straight and Transitional Straight Silencers: Minimum #22 gauge lock forming quality galvanized steel.
- .2 Elbow and Transitional Elbow Silencers: Minimum #18 gauge for elbow lock forming quality galvanized steel.

- .3 High Transmission Loss (HTL) Rectangular and Elbow Silencers: # 16 or #10 gauge stitch-welded and caulked galvanized steel in accordance with drawing schedule.
- .4 Circular Silencers: Lock forming quality galvanized steel with minimum gauges as follows:
 - .1 300 mm to 660 mm (12" to 26") dia. - #22 gauge;
 - .2 675 mm to 1.52 m (27" to 60") dia. - #18 gauge;
 - .3 1.55 m to 2.13 m (61" to 84") dia. - #16 gauge.

2.03 Interior Baffle-Liner-Bullet Material

- .1 Minimum #22 gauge lock forming quality galvanized steel.

2.04 Interior Baffle Transition

- .1 Transitioning for interior transition silencers is to occur internal to silencer such that height of air passage is uniformly changing with the length of the air passage.

2.05 Acoustic Media Material

- .1 For silencers as specified and/or scheduled, acoustic quality insulation which does not contain any formaldehydes, phenolic resins, or volatile organic compounds that can off-gas, but containing cotton fibres treated with an EPA registered non-toxic borate solution, "flash dried" to actively inhibit the growth of mould, mildew, bacteria, and fungi.

3 Execution

3.01 Installation of Silencers

- .1 Provide silencers. Ensure silencers are installed with airflow arrows in the direction of airflow.
- .2 Support each silencer independent of connecting ductwork.
- .3 Properly layout ductwork for silencer locations to provide a minimum of 5 diameters of straight duct upstream of silencer and 10 diameters of straight duct downstream of silencer.
- .4 Unless otherwise specified, do not install silencers in walls or slabs.
- .5 Seal all silencer connections to ducts with proper fire/smoke rated duct sealer.

End of Section

1 General

1.01 Section Includes

- .1 Heat Recovery Ventilators

1.02 Submittals

- .1 Submit shop drawings/product data sheets for heat recovery ventilators, including accessories, and all required power and control wiring schematics.
- .2 Submit with delivery of each unit a copy of the factory inspection report, and include a copy of each report with O & M Manual project close-out data.
- .3 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.
- .4 Supply a spare filter set for each ventilator and store at site where directed prior to Substantial Performance of the Work.
- .5 Submit a signed extended warranty direct from manufacturer to Owner covering the energy recovery wheel from material and workmanship defects for an additional 4 years after Contract warranty expires.
- .6 Supply reviewed copies of ventilator/curb assembly shop drawings or product data to trade who will cut roof openings for ventilators, and ensure openings are properly located.

1.03 Quality Assurance

- .1 Heat recovery ventilator manufacturers are to be current members of Air Movement and Control Association International Inc. (AMCA), and fans are to be rated (capacity and sound performance) and certified in accordance with requirements of following standards:
 - .1 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating;
 - .2 AMCA Standard 211, Product Rating Manual for Fan Air Performance;
 - .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans;
 - .4 AMCA Standard 311, Product Rating Manual for Fan Sound Performance;
 - .5 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans;
 - .6 AHRI Standard 1060, Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment;
 - .7 ASHRAE 84, Method of Testing Air-to-Air Heat/Energy Exchangers;
 - .8 UL 1812, Ducted Heat Recovery Ventilators;
 - .9 CSA or ETL certification for all electrical components.
- .2 Provide two (2) year warranty and contractor to extend manufacturer warranty where required.
- .3 Acceptable manufacturers are:
 - .1 Greenheck Fan Corp. – ERVe Series;
 - .2 Cook – ERV Series;
 - .3 PennBarry – D Series;
 - .4 Ruskin – EVT Series;

.5 Spinnaker – RERV Series.

2 Products

2.01 Heat Recovery Ventilators

- .1 Minimum 65% effectiveness rate in summer and winter at conditions selected.
- .2 Permanently bonded silica gel desiccant on polymer media (or aluminum media preferred) and capable of being periodically cleaned (no spray-on coated desiccant);
- .3 Exhaust only defrost freeze protection.
- .4 Modular sectional wheel or slide out chassis to facilitate service.
- .5 Variable speed wheel control.
- .6 Provided with 24" (600mm) roof curb.
- .7 30/30 disposable pleated filters on intake and exhaust.
- .8 Exhaust hoods w/ bird screens & washable filter on intake
- .9 Premium efficiency motors and belt drive blower sections with integral vibration isolation.
- .10 Electrical/mechanical controls to suit TAC/Distech BAS system.
- .11 Motorized intake damper (spring closed if electrical power if lost);
- .12 Factory or field installed galvanized latches c/w ss screws or equivalent to suit 2" (50mm) padlock by WRDSB.
- .13 Electrical disconnect to be field supplied and installed by elec. contractor.
- .14 Factory assembled, internally wired heat recovery ventilators in accordance with drawing schedule, and with AHRI certified energy recovery ratings.
- .15 Interior Unit Casings and Frame: Internal frame type casing constructed of heavy-gauge G90 galvanized sheet steel with interior surfaces lined with 25 mm (1") thick, 24 kg/m³ (1-½ lb./ft.³) density coated glass fibre duct lining material meeting 25/50 flame spread/smoke developed ratings when tested in accordance with CAN/ULC S102, Surface Burning Characteristics of Building Materials and Assemblies, and installed with all exposed edges tucked under flanges. Additional features and requirements as follows:
 - .1 casings complete with factory sealed metal-to-metal joints, a solid integral base with up-turned lips around bottom openings, separate openings and knock-outs for power and control wiring conduit connections, top panels, where joints are required, are to be equipped with a standing seam, and all metal exposed to weather is to be factory cleaned, primed, and finished with baked enamel;
 - .2 removable gasketed panels or hinged gasketed access doors provided for access to all interior components;
 - .3 stainless steel drain pan pitched for positive drainage and equipped with captive condensate drain pipe connection.
- .16 Exterior Unit Casings and Frame: Internal frame type double wall weather-proof casing constructed of heavy-gauge G90 galvanized sheet steel, minimum #18 gauge for exterior panels, minimum #24 gauge with interior panels, with 25 mm (1") thick, 24 kg/m³ (1-½ lb./ft.³) density coated glass fibre insulation material meeting 25/50 flame spread/smoke developed ratings when tested in accordance with CAN/ULC S102, Surface Burning Characteristics of Building Materials and Assemblies and secured in place between panels such that it will not sag. Additional features and requirements as follows:

- .1 weather-tight casings, complete with factory sealed metal-to-metal joints, a solid integral base with up-turned lips around bottom openings, and separate openings and knock-outs for power and control wiring conduit connections;
 - .2 removable gasketed panels or hinged gasketed access doors provided for access to all interior components;
 - .3 stainless steel drain pan pitched for positive drainage and equipped with captive condensate drain pipe connection;
 - .4 downturned design air intake and exhaust hoods constructed and factory finished as for casings, each with an "A" water penetration classification rating up to 200 mm/hr (8"/hr) rainfall at 22 m/s (50 mph) when tested in accordance with AMCA Standard L-500, and washable aluminium mesh pre-filters;
 - .5 Intake and exhaust hoods c/w bird screens & washable filter on intake
 - .6 minimum 200 mm (8") high, full perimeter, galvanized steel insulated roof curb supplied loose with each unit for field assembly, consisting of die-formed sections with gasket material for installation between curb and unit base.
- .17 Enthalpy type energy recovery wheel for both sensible and latent heat recovery, designed to ensure laminar air flow, with energy transfer ratings in accordance with ASHRAE 84 and AHRI certified to AHRI 1060, designed to transfer moisture entirely in vapour phase, consisting of removable segments for larger wheels, and complete with:
- .1 silica gel desiccant permanently bonded to lightweight polymer media mounted in a stainless steel rotor;
 - .2 bearings selected for a minimum L-10 life in excess of 400,000 hours;
 - .3 high-strength urethane drive belt factory installed in a pre-stretched state, and a motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical;
 - .4 frost control protection with an electric pre-heater.
- .18 Disposable glass fibre media filters, ULC listed Class 2, side removable, 50 mm (2") thick, pleated, MERV 8 rating, factory or field installed in a die-formed galvanized steel filter rack at air intake opening.
- .19 Centrifugal, draw-through within reference to the energy recovery wheel, double width and inlet exhaust and supply fans with forward curved blades, belt driven or direct driven as indicated, statically and dynamically balanced, mounted to unit base with neoprene vibration isolation, and equipped with:
- .1 ground and polished steel fan shafts mounted in permanently lubricated sealed ball bearing pillow blocks selected for a minimum L-10 life in excess of 200,00 hours at maximum operating speed;
 - .2 motors and where indicated, belt drives conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical.
- .20 Each ventilator is to be equipped with a sealed and factory pre-wired control box containing terminal blocks for power and control wiring connections, integral door interlocking disconnect switch, an overload protected contactor for each motor, fuses, and 24 VAC secondary control transformer.
- .21 Control system in accordance with drawing control schematic/sequence, and to include if indicated, all required hardware and circuitry for connection into building automation system using protocol as specified with the system.
- .22 Factory supplied, mounted, and wired variable frequency drives conforming to requirements of Section 20 05 13.13 - Variable Frequency Drives for Mechanical Equipment.
- .23 Auxiliary coil(s) rated and certified in accordance with AHRI Standard 410, Forced-Circulation Air-Cooling and Air-Heating Coils, drainable, designed and constructed to meet requirements of the ASME Code Category "H" as a registered fitting, and complete with a CRN. Coil data, performance, and specific features not specified below are to be in accordance with drawing detail. Each coil is to be complete with:
- .1 slide in/slide out galvanized steel mounting framework;

- .2 16 mm (5/8") O.D. seamless copper tubes with 1.24 mm (1/16") thick tube walls;
- .3 aluminum fins mechanically bonded to tubes;
- .4 welded Schedule 40 ASTM A53 seamless steel pipe headers with same end supply and return connections, and 9.5 mm (3/8") tapings for an air vent and a drain valve;
- .5 flanged #14 gauge type 304 stainless steel casing designed to drain off standing water;
- .6 for cooling coils only, an insulated stainless steel drain pan sloped for positive drainage from all points and equipped with a captive drain pipe connection coupling.

3 Execution

3.01 Installation

- .1 Provide heat recovery ventilators.
- .2 For suspended units, provide galvanized steel mounting brackets with vibration isolators and suspend each unit, level, and plumb, by means of hanger rods. Provide supplementary support steel as required.
- .3 Secure each indoor floor mounted ventilator in place, level and plumb, on neoprene-steel-neoprene vibration isolation pads on a concrete housekeeping pad.
- .4 Supply an assembled roof curb for each outdoor roof mounted ventilator and hand to roof trade at site on roof. Carefully locate and size roof openings. Provide gasket material supplied with curb on perimeter of curb and secure ventilator in place.
- .5 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 - Seismic Controls for Mechanical Equipment.
- .6 For ventilators with auxiliary hydronic coils, connect each coil to system valved hydronic piping with flexible connectors in accordance with Section 23 21 00 - Hydronic Piping and Pumps. Provide trapped condensate drainage piping connection to cooling coil condensate drain pans in accordance with Section 22 13 00 – Facility Sanitary Sewerage.
- .7 Coordinate power wiring connection and provision of a disconnect switch for each ventilator in accordance with electrical work Specification where power wiring is specified.
- .8 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system manufacturer certification requirements.
- .9 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system start-up requirements.

3.02 Demonstration and Training

- .1 Include for a ½ day on-site heat recovery ventilator operation demonstration and training session. Training is to be a full review of all components including, but not limited to, a full heat recovery ventilator internal inspection, construction details, operation, maintenance, abnormal events, and setting up controls.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data for all units. Include:
 - .1 certified fan performance curves;
 - .2 estimated sound power levels to be expected across individual octave bands in dB;
 - .3 certified power and control wiring diagrams which differentiate between factory and site wiring;
 - .4 dimensioned layouts, including dimensioned curb layouts and duct penetrations, as applicable;
 - .5 product data for fan motors and drives;
 - .6 all items shipped loose for site installation.
- .2 Submit with delivery of each unit a copy of the factory inspection and fire test report, and include a copy of each report with O&M manual project close-out data.
- .3 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.
- .4 Submit spare air filters as specified in Part 2 of this section.
- .5 Supply reviewed copies of curb assembly shop drawings or product data sheets to trade who will cut roof openings for ductwork, and ensure openings are properly sized and located.
- .6 Submit signed copies of manufacturer's extended warranties as follows:
 - .1 stainless steel gas fired unit heat exchanger: 10 years;
 - .2 refrigerant compressor(s): 5 years;
 - .3 integrated modular control: 3 years.

1.02 Quality Assurance

- .1 Heating and air conditioning equipment is to be rated (capacity, performance, efficiency and sound) and certified in accordance with requirements of following Air-Conditioning, Heating and Refrigeration Institute Standards:
 - .1 ANSI/AHRI 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment;
 - .2 ANSI/AHRI 270, Sound Performance Rating of Outdoor Unitary Equipment;
 - .3 ANSI/AHRI 340/360, Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
- .2 Heating and air conditioning equipment is also to be in accordance with requirements of following Codes, Standards, and Regulations:
 - .1 CSA B52, Mechanical Refrigeration Code;
 - .2 CAN/CSA-C22.2 No. 236/UL 1995, Heating and Cooling Units;
 - .3 ANSI/ASHRAE/IES 90.1, Energy Standard for Buildings Except Low Rise Residential Buildings;
 - .4 CSA or ETL certification and labelling for all electrical components;

- .5 CAN/CSA B149, Natural Gas and Propane Code;
- .6 governing local Codes and Regulations.
- .3 Gas fired heating and air conditioning units are to be installed by licensed journeyman gas fitters.
- .4 Acceptable manufacturers are:
 - .1 CME (Custom Mechanical Equipment).

2 Products

2.01 Outdoor Air Conditioning Units

- .1 GENERAL: Furnish and install multizone systems, complete with Open Protocol Direct Digital Controls, by Alerton or Owner pre-approved equal. The units shall be a standard product of a firm regularly engaged in the manufacture of heating/cooling equipment. The equipment shall be shipped completely factory tested and internally ready for field connections. Provide thermal overload protected motors.
 - .1 All wiring shall be in compliance with NEC.
- .2 HEATING/COOLING SYSTEM: The total certified heating/cooling capacity shall not be less than scheduled. The compressor power input shall not exceed that of the unit specified.
- .3 SPECIFIED EQUIPMENT: Approved equipment must include multiple independent heating, cooling, fan and economizer sections to provide system redundancy, improve reliability, increase system efficiency, and reduce energy usage. Equipment that requires reheat will not be acceptable. Any manufacturer not meeting these specifications must provide a detailed explanation of the deviation(s) from the specifications and all performance information necessary for the owner to complete a comparative life cycle cost analysis. The Owner reserves the right to reject any bids not meeting all specifications.
- .4 TECHNICAL SPECIFICATIONS: The gas fired multizone units shall be factory assembled one-piece penthouse design and be listed by ETL as an approved HVAC appliance. The following components shall be factory installed, wired and plumbed inside the penthouse:
 - .1 High efficiency two-stage, heating section (minimum 95% AFUE)
 - .2 Evaporator coils
 - .3 Fully modulating economizer dampers
 - .4 Low voltage control center
 - .5 Line and low voltage wiring in the penthouse
 - .6 Gas lines with single point exterior connection
 - .7 Condensate piping to single point interior connection
 - .8 Refrigerant piping to exterior of penthouse
 - .9 Combustion intake and exhaust piping to termination point
 - .10 Supply air zone head matching existing ductwork
 - .11 Interior lights and ground fault convenience outlet
 - .12 30% efficient 2" MERV13 pleated filters

- .13 Return CO2 sensors
 - .14 Bi-flow liquid line driers
 - .15 Barometric pressure relief dampers
 - .16 Condenser rails for mounting condensers
 - .17 Main exterior electrical disconnect switch
 - .18 Step-down transformers
 - .19 Phase Protection
 - .20 Open protocol DDC Controller – BacNet Web Ready
- .5 STRUCTURE AND INSTALLED COMPONENTS: Penthouse shall be constructed of coated, high ribbed galvanized steel siding and trim (25 year performance warranty) with R-9 insulation. Standard color is burnished slate. All louvers shall be coated to match the penthouse with integral bird screen. Unit base shall be designed to set on existing roof curbs and use existing ducts without the need for any transition curb or ducts. Lifting lugs shall be provided for rigging.
- .6 SERVICE ACCESS: All components, wiring, and inspection areas shall be completely accessible through removable panels or doors.
- .7 HEATING: Primary heating to be provided by York THE60B heat pumps. Low ambient heating shall be high efficiency (95% AFUE), two-stage, aluminized steel heat exchanger with sealed combustion, condensing type utilizing 100% outside air for combustion. Units shall be certified by AGA Laboratories and the ratings certified by GMA and tested according to DOE test procedures and FC labeling regulations. Heating of air cooled by mechanical means or through an economizer will not be allowed.
- .8 SUPPLY AIR FAN: An independent, 1 Hp fan section is required for each heating section. Each blower assembly shall be statically and dynamically balanced. Maximum speed is 1100 RPM. Blower speed shall be reduced a minimum of one third of the design rotational speed to lower energy costs and reduce drafts when space conditions allow. Fan speed must be adjustable through digital blower balancing control within the user interface or the BAS. Change in blower speed must be gradual utilizing a VSM (DC) motor or Variable Frequency Direct Drive. Control sequence and equipment must be pre-approved by the Owner. Belt-driven fans shall not be acceptable. The entire assembly shall be resiliently rubber mounted.
- .9 COOLING: An independent, direct expansion single-stage cooling system shall be provided for each heating section. Evaporator coils shall be made with seamless copper tubing, aluminum fins mechanically bonded to durable copper tubes, and galvanized steel frame. Balanced port, adjustable thermal expansion valves shall be factory-installed.
- .1 Refrigerant shall be R-410a. Each coil shall be thoroughly tested under high pressure and charged with nitrogen prior to shipment to further assure leak-proof construction.
 - .2 An independent air-cooled condensing unit shall be provided for each cooling coil. Units shall be set directly on the roof or on the existing roof curb using devices provided by the manufacturer.
 - .3 Condenser fan shall be TEFC, permanently lubricated direct drive motor with vertical discharge, rain shield and louvered steel top fan guard.
 - .4 All refrigerant piping shall be type "L" hard drawn refrigerant grade copper tubing. Backseating brass service valves shall provide access to refrigerant system. Field installed piping shall be as required by the manufacturer.
 - .5 Condenser coil is to be factory tested to insure leak-proof construction. Entire coil shall be accessible for cleaning.
 - .6 Refrigerant compressor shall be a Copeland Compliant Scroll. Unit shall be rated for a minimum 11.3 EER at ARI conditions with the evaporator coil and condenser section provided. The compressor shall be resiliently mounted, have

- built-in crankshaft lubrication, crankcase heater, discharge temperature limited, and current-and temperature- sensing motor overloads.
- .7 The system shall be protected by high and low pressure switches and a five-minute compressor timed off cycle controller (anti-recycle timer).
- .8 Unit Casings: Design for outdoor installation and provide weather protection for components and controls and have a PVC coated steel wire coil guard.
- .10 ECONOMIZERS: An independent economizer section shall be provided for each heating section. Units shall be fully modulating with enthalpy or dry-bulb changeover and a manually adjustable minimum damper position. Outdoor air intake damper leakage shall not exceed three cfm/sq. ft. at 3" static pressure differential across the damper.
- .11 FILTERS: Sufficient surface area on 2" pleated, 30% efficient filters shall be provided (Farr 30/30 or equivalent). All air shall pass through these filters prior to entering any fan, coil or heat exchanger.
- .12 UNIT CONTROL – DDC CONTROLLER SPECIFICATION: The controller used shall be 32-bit microprocessor based and graphically programmable to control each unit with 148 input/output (I/O) points:
- .1 Up to 76 universal inputs (individually jumper-selectable to select either a dry contact, thermistor, 0-20 mA, 0-5 VDC, 0-10 VDC, or RTD...with 12-bit resolution on all analog inputs)
- .2 Up to 40 digital outputs (relayed outputs with individual LED indication and individual HOA switches)
- .3 Up to 40 analog outputs (0-10 VDC or 0-20 mA) Capacity requirements greater than 148 I/O's can be added as an option. The maximum number of inputs and outputs the controller can accept is 180 (92 universal inputs, 48 digital outputs and 48 analog outputs).
- .4 The controller must be capable of sensing CO2 levels by zone and modulating the fresh air by zone to established levels if required.
- .5 There shall be no limits on the number of control loops that the controller can handle nor any programming limitations imposed. The controller shall have an on-board, jumper-selectable EIA-232 or EIA-485 open protocol port that supports the following communication protocols: BACnet (modes supported: MS/TP, PTP, and ARCnet), Modbus (modes supported: RTU and ASCII), N2 Bus, and LonWorks. If a controller does not support all of these protocols, then the equipment manufacturer shall include and provide in their price all of the necessary additional communication gateway(s) to support all of these protocols.
- .6 All programming memory shall be stored in 16 MB non-volatile battery-backed RAM (with 12 MB available for use), 8 MB Flash Memory and 32-bit memory bus, thus requiring no battery-backup and providing for rugged electrical noise immunity. The controller shall contain an on-board battery-backed(up to 10 years) hardware clock for stand-alone scheduling capability and accurate recording of date/time on alarm events and data logging. The time/date maintained by the hardware clock shall automatically adjust for daylight savings time and leap years.
- .7 As simple-to-use keypad/display (KPD) unit with a minimum 4 line by 40 characters per line backlit LCD with 22 function buttons will be supplied with each unit. Software and hardware features of the KPD shall include:
- .1 Custom definable displays and menus
- .2 Alarm indicator light and horn as well as an acknowledge (or "mute") button. The alarm light shall be active anytime there is an active alarm, and the alarm horn shall be active anytime there is an active, unacknowledged alarm. It shall be software selectable which individual alarm conditions, if any, that activate the horn.
- .3 Alarm history buffer displaying the 64 most recent alarms, including custom alarm text and time stamping of time of alarm occurrence and time when the alarm condition returned-to-normal
- .4 User password protection for KPD editing access as well as separate technician password protection

- .5 View and adjustment of operating schedules – normal, holiday, and override schedule modes
 - .6 Ability to connect or disconnect the KPD “on-the-fly” without the need to cycle power to the controller for the KPD to be fully functional.
 - .7 Option to mount the KPD component itself up to 1,500 feet away from the unit
 - .8 Ability to reset the controller's time/date
 - .9 Ability to field-adjust through the KPD which protocol the controller communicates through its open protocol port as well as the ability to adjust certain protocol parameters (such as baud rate, stop bits, parity, protocol mode, etc.)
- .13 DUCT SYSTEM: Unit shall have factory-installed internal duct system. Individual zone heads shall be sized and located for connection to the existing zone systems. The return air opening shall include a protective grate. Zone balance dampers shall be provided when required to allow aggregate balancing of each zone on the building roof. Sub-zone control dampers actuators shall be easily accessible through external access panels without removing any screws, bolts, etc.
- .14 ELECTRICAL: 208 volt, three phase with main over current protection device and branch circuit breakers shall be provided in each unit. Condensing unit disconnect switches shall be mounted on the exterior of the penthouse adjacent to the respective condensing units. A main electrical disconnect switch shall be factory mounted on each unit. Unit shall include a factory-installed power quality monitor to disable unit during phase loss, high voltage or low voltage conditions.
- .15 WARRANTIES: The unit shall include the following manufacturer's parts only warranties with no labor allowance unless noted:
- .1 Heat exchangers shall have a ten-year limited warranty with 50 OF minimum inlet air.
 - .2 Solid-state ignition modules shall have a one-year limited warranty.
 - .3 Blower motors shall have a limited one-year warranty.
 - .4 The compressor shall have a limited five-year warranty.
 - .5 All other covered components shall have a limited one-year warranty.
 - .6 Contractor to extend manufacturer standard warranty where required for full (2) year coverage and provide PM service during warranty. Contractor to provide info to the Board on all available extended warranties and procure extended warranty registration as available from each manufacturer.
- .16 EQUIPMENT MANUFACTURER REQUIREMENTS:
- .1 Inspect existing equipment and site prior to construction
 - .2 Complete system design to match equipment with building requirements.
 - .3 Provide customized submittal data matching job requirements.
 - .4 Fabricate all equipment in accordance with job schedule.
 - .5 Control equipment delivery to meet schedule requirements.
 - .6 Provide a project manager to supervise the installation.
 - .7 Start-up equipment with the assistance of the installing contractor.
 - .8 Complete detailed training of system operation, maintenance and trouble-shooting for the owner.
 - .9 Provide Operating and Maintenance instructions, including color-coded unit wiring diagrams showing actual wiring colors.

- .17 ROOF CURB: Minimum 600 mm (24') high prefabricated and insulated curb conforming to requirements of National Roofing Contractors Association where required.

3 Execution

3.01 INSPECTION:

- .1 Examine areas and conditions under which multizone units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF MULTIZONE UNITS:

- .1 Install multizone units where indicated, in accordance with equipment manufacturer's instructions with unsatisfactory conditions corrected.
- .2 Factory mounted integral disconnect switches shall be provided for all units.

3.03 TESTING:

- .1 Upon completion of installation of multizone units, start up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

3.04 CLEANING UP:

- .1 Upon completion of work, remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

3.05 COORDINATION OF INSTALLATION

- .1 Prior to production of custom configured equipment, the responsible party must confirm the equipment, as described in the submittals, to be correct by signing and returning the document to CME.
- .2 CME will not be responsible for alterations exterior to our product or outside the submittal description.
- .3 CME will send a project manager, familiar with the procedures and equipment, to the site, with the delivery, as specified in the quote, please check this line item. His responsibilities are to advise the contractor on the overall placement process, to observe setting the equipment and training on the controls and equipment with appropriate personnel. Since the CME project manager's on site time is scheduled, therefore limited, prompt powering of the PMZ unit is essential in order that he completes the checkout process and training on time as outlined in the quote. The CME project manager is not responsible for mechanical startup items. It is common for actual powering and firing of some or all condensers and furnaces to take place after he has completed his tasks and left the site. If the scope of the CME project manager cannot be completed due to project delays, additional charges will apply for return site visits.

3.06 CONTRACTOR INCLUSIONS AND CONSIDERATIONS:

- .1 Adequate crane and rigging for removal of old and placement of new equipment. Spreader bar device is advised for setting new units. Provide means to transport old equipment to appropriate location.
- .2 Assure detachment of old unit from existing ducts, electrical, condensate gas and all other attachments.
- .3 Curb preparation including: clean-up, fire proofing per local code (PLC), relocation or removal of existing curb barriers and bracing as needed, preparation of existing supply duct and application of the supplied curb gasket.
- .4 Placement of: unit, condenser mounting rails and condensers.
- .5 Connection of primary, secondary and control wiring: Connect existing building primary wiring to single point terminal on PMZ (fused disconnect included with PMZ). Resizing the existing building circuit fusing may be necessary, copper wire is mandatory at the PMZ junction box. Connect condenser primary and control wiring to disconnects and terminations on PMZ exterior. (Whips

- and wire field supplied.) Identify and connect control wiring from room sensors to terminal inside PMZ (PLC). Room sensors are supplied and require 2 conductor cable, 3 for full functionality, and can generally utilize the existing wire, splicing often required. Replacement of the existing building sensor wiring by the contractor may become mandatory. Additional wire and conduit for these connections are not provided with the PMZ package.
- .6 Route PMZ single point condensate drain to appropriate building drain (PLC); this is commonly a frost free drain location below roof level.
 - .7 Connect and evacuate refrigerant piping and devices between condensers and connections on exterior of PMZ. Condensers 5 ton and smaller are pre-charged with refrigerant adequate for fifteen feet of piping. Refrigerant piping is included with condensers placed in standard, cantilevered locations only. Field refrigerant piping modifications and/or additions may be required. Additional fittings and refrigerant are not supplied with the PMZ. Piping is not included for remote condensers.
 - .8 Since connections and conditions under the old unit are unknown until removal, the contractor should be prepared to supply sheet metal, electrical and other materials to assure timely and satisfactory installation and operation. CME will not be responsible for additional charges due to extended install time. Off-loading of the delivery truck must be done within two hours of scheduled delivery time to avoid demurrage charges.
 - .9 Arrange to have the electrical main power connected and energized as soon as possible after each PMZ is set in order to establish blower and control operation.
 - .10 Complete the single point gas connection from the building and confirm gas supply pressure. Gas piping internal to the PMZ must leak-checked after delivery by the installing contractor.
 - .11 Supply air delivery must be field adjusted to satisfy each zone requirement.
 - .12 The most common problem after startup is crossing of the zone sensor wiring. Crossed zone pairs will tend to over heat and over cool. Make sure each zone sensor is traced and connected to the proper terminal in the PMZ control panel.

3.07 DEMONSTRATION AND TRAINING

- .1 Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including, but not limited to, a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for all heating only air units. Include following:
 - .1 certified fan performance curves;
 - .2 certified sound power data;
 - .3 hardware for section-to-section site connections;
 - .4 dimensioned layouts, including dimensioned curb layouts as applicable;
 - .5 product data for fan motors.
- .2 Submit with delivery of each furnace a copy of the factory inspection and fire test report as specified in Part 2 of this section, and include a copy of each report with O & M Manual project close-out data.
- .3 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.
- .4 Submit spare air filters as specified in Part 2 of this section.

1.02 Quality Assurance

- .1 Heating only air units and installation are to be in accordance with requirements of following:
 - .1 all applicable Provincial Codes and Standards;
 - .2 CAN/CSA B149, Natural Gas and Propane Installation Codes;
 - .3 CSA or cETL listed and labelled electrical components.
- .2 Unit installation tradesmen are to be journeyman and licensed gas fitters.
- .3 Contractor to extend manufacturer standard warranty where required for full two (2) year coverage and provide PM service during warranty. Contractor to provide info to the Board on all available extended warranties and procure extended warranty registration as available from each manufacturer.
- .4 Acceptable manufacturers are:
 - .1 Engineered Air – DJE (DJX) Series;
 - .2 AAON – RN Series;
 - .3 Daikin – RDS Series;
 - .4 Bousquet – BC Series.

2 Products

2.01 Gas Fired Heating-Only Air Handling Units

- .1 Air-tight, weather-proof heating only air units, approved for operation in ambient temperatures of -50°C (-60°F), in accordance with drawing schedule and details, factory inspected and fire tested with an inspection and fire test report prepared and submitted, and following additional performance features:
 - .1 units are to be suitable for operation at any supply gas pressure between 1.7 kPa and 3.5 kPa (0.25 psi and 0.51 psi);

- .2 unless otherwise specified, sound emitted through casings or intakes of roof mounted units at maximum air flow rate is not to exceed 78.4 dBA at 1 m (4'), and for interior spaces, sound emitted through supply and return air openings is not to exceed 82 dBA at 1.5 m (5').
- .2 Complete with free cooling economizer / CO2 controlled fresh air via TAC/Distech BAS system.
- .3 Power exhaust or modulating relief damper (set to maintain space slightly pressurized at approx. 0.05"wc / 12Pa)
- .4 Complete with premium efficiency motor(s).
- .5 Blower section(s) c/w integral vibration isolatio.
- .6 Max 85dB sound rating
- .7 2" (50mm) 30/30 disposable filters (350 fpm / 1.8 mps max filter velocity).
- .8 Bousquet heat exchangers c/w inspection port to allow PM service on exchanger w/out disassembling unit enclosure.
- .9 VFDs (if any) shall have a bypass switch to ensure fan blower operation without need for programming or re-wiring (for emergency / after hrs use).
- .10 Dynamically balanced fans and drives (factory or field as required).
- .11 Hinged service panels suitable for padlocks (field install stainless steel or galvanized latches c/w ss screws). 2" padlock by WRDSB.
- .12 Sectional, double wall insulated casing and section construction with dimensions and arrangements as shown and detailed on drawings and as follows:
 - .1 rigid, full perimeter structural channel iron base frame with reinforcing channels cleaned and coated with rust resistant primer, lifting lugs and identified lifting points;
 - .2 minimum #16 gauge G90 galvanized sheet steel exterior casing panels, #22 gauge G60 galvanized steel liner panels over all interior insulation including underside of floor, with over-lapped roof panels, all joints neatly caulked with water resistant sealant, and rain shields over all access doors;
 - .3 50 mm (2") thick, minimum 48 kg/m³ (3 lb/ft³) density semi-rigid glass fibre acoustic insulation meeting 25/50 flame spread/smoke developed ratings when tested to CAN/ULC S102, secured in place by means of adhesive and pins;
 - .4 double wall insulated access doors constructed as for casing panels, of sufficient size and number to permit physical entry into sections from both sides of unit for servicing of filters, fans and motors, burners, and other equipment requiring maintenance and service, and each complete with:
 - .1 full perimeter captive gasketing;
 - .2 full length galvanized steel hinges;
 - .3 2 lever lock roller handles operable from both inside and outside casing;
 - .4 for sections such as fan sections requiring full access, double doors of sufficient size with a removable mullion.
 - .5 galvanized steel intake hood complete with storm louvre, aluminium mesh birdscreen, motorized inlet damper, "V" bank filter framing, and 50 mm (2") thick, UL Class 1, 25% to 30% efficient MERV 7 disposable glass fibre filters with an extra set of filters in identified packaging for each unit;
 - .6 clean and prime casing, both inside and outside, and finish with epoxy enamel applied to all panel surfaces, including exterior undersides.

- .13 Fully modulating direct fired type burners capable of minimum 5:1 turndown ratio and located in a burner section with a heat treated glass observation port for full viewing of flame, and a control panel/gas manifold vestibule with access door and weather-proof electric heater with thermostat, a 120 volt marine light with guard and lighted switch, and a duplex 15 ampere GFI receptacle factory wired to a separate 120 volt, 1-phase circuit with disconnect switch. Burner efficiency is to limit products of combustion to maximum 5 ppm carbon monoxide and 0.5 ppm nitrogen dioxide, and equip burner with:
 - .1 adjustable profile plates, stainless steel combustion baffles, non-clogging gas ports, and spark-ignition intermittent pilot with 100% flame safety shut-down;
 - .2 pre-piped gas manifold with main gas pressure regulator, manual shut-off and test firing valves, main and auxiliary gas automatic shut-off valve, a modulating control system, pilot pressure regulator and automatic shut-off valve, pilot needle valve, and multiple test ports.
 - .3 flue extension kit.
- .14 Burner control, located in burner control/manifold vestibule, factory pre-wired, and consisting of:
 - .1 blower motor starter with ambient compensated overloads, and auxiliary contacts;
 - .2 primary 120 volt control transformer;
 - .3 6000 volt ignition transformer;
 - .4 control circuit breaker and service switch;
 - .5 automatic reset temperature high limit;
 - .6 solid-state flame safeguard relay with LED status and flame rod;
 - .7 discharge temperature control sensor with RTS;
 - .8 all hardware required for site connection of the remote control panel.
- .15 AMCA rated and certified double width and inlet centrifugal fan with forward curved blades, secured to a heavy-duty machined and polished steel shaft with an operating speed not to exceed 75% of its first critical speed, and statically and dynamically balanced. Fan motor, V-belt drive, and OSHA guard in accordance with requirements specified in Section 20 05 00 – Common Work Results for Mechanical.
- .16 Surface wall mounting (to a recessed or surface mounting outlet box) supervisory control panel with 2 switches, 5 indicating lights including "Clogged Filter", a temperature selector, and a LED discharge temperature readout.
- .17 Roof mounting curb factory supplied loose and ready for site assembly and insulation, 600 mm (24") high, complete with wood nailer and site assembly hardware.
- .18 Electric disconnect to be field supplied and installed by electrical division.
- .19 GFCI receptacle (where required) to be field wired by electrical division.

3 Execution

3.01 Installation of Gas Fired Heating Only Rooftop Unit

- .1 Provide a gas fired heating only unit on roof.
- .2 Unless otherwise specified or required, provide required rigging and hoisting/moving equipment required to move units to required location. Perform rigging/hoisting/moving in accordance with unit manufacturer's directions and details.

- .3 Supply a curb for each unit, assemble curb, and hand curb to roofing trade on roof for installation and flashing into roof construction. Provide continuous gasketing around perimeter of curb between curb and unit mounting frame. Insulate curb with rigid weather-proof board type insulation in accordance with curb manufacturer's details.
- .4 Install components shipped loose with units. Install a discharge air temperature sensor in supply ductwork approximately 2 m (6-½') downstream of unit and in accordance with manufacturer's recommendations.
- .5 Brace and secure unit in accordance with requirements specified in Section 20 05 48.16 - Seismic Controls for Mechanical Systems.
- .6 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system manufacturer certification requirements.
- .7 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system start-up requirements.

3.02 Demonstration and Training

- .1 Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

.1 General Requirements

- .1 Conform to General Conditions for Mechanical Trades
- .2 Related Work Specified Elsewhere
 - (1) General Conditions for Mechanical Trades
 - (2) Heating, Ventilation & Air Conditioning
 - (3) Heating, Ventilation & Air Conditioning Equipment
 - (4) Electrical

.2 Description of System

- .1 Furnish and install all components, devices and control wiring for a fully integrated Energy Management and Environmental Control System incorporating Direct Digital Control (DDC), and equipment monitoring. The system shall control/monitor HVAC and plumbing equipment and systems as specified in this section. The work shall include but is not limited to the following:
 - (1) All necessary hardware, software, control panels, web access modules, control wiring, field devices, installation, documentation and owner training as specified.
 - (2) The installed system shall incorporate electronic and digital control devices to perform the control sequences and monitoring outlined herein. Specific control sequence requirements are as detailed elsewhere in this Section of the specification.
 - (3) VVT zone control dampers shall be installed in the duct system by the Sheet Metal Trade complete with necessary duct transitions, access doors, etc. The Temperature Control Contractor shall be responsible for coordination with the HVAC Contractor and the installation of the actuators.
 - (4) Control valves shall be installed in the piping system by the Mechanical Trade complete with transitions and unions as required.
 - (5) Testing, debugging, calibrating, adjustment, programming and confirmation of total system operation.

.3 Manufacturer and Installing Contractor

- .1 The temperature control manufacturer shall be Distech Controls – local rep 519-893-2638.
- .2 Any new building must be a seamless extension of the current Energy Management and Building Control System.
 - (1) The existing TAC Vista software is, and shall continue to be, the only head-end BAS server for the entire School Board.
 - (2) The head-end server contains the secure Energy Management Settings (i.e. Master Setpoints & Schedules) that are sent to all schools in real-time. The control system must be an extension of the head-end server and be able to be managed exclusively through the Vista head-end server.
 - (3) Monitoring of all school board control systems are done in real-time and must be presented at the exclusive Vista head-end server as first-priority data.
 - (4) The Vista head-end server has all the required controller databases and software to be able to centrally maintain and modify network configuration and controller software for the entire School Board. The Vista head-end server is the only system that can access the LacNet programming variables inside the controllers for real-time configuration of setpoint and time scheduling parameters.
 - (5) The graphics and controller database must be presented inside the Vista head-end server in its native format in order to preserve the real-time speed, integrity and multi-site administration of the entire system.
- .3 The controls company shall have a service office and maintenance facility within 6 kilometers of the Waterloo Region District Public School Board main office. The controls company shall be able to provide service to any school within 4 hours during normal working hours.

.4 Quality Assurance

- .1 The system components shall be listed by Underwriters Laboratories Inc. and Canadian Standards Association.

- .2 The system control products shall be stored and handled according to manufacturer's recommendations.
- .3 The work shall be performed by skilled technicians all of whom shall be properly trained and qualified for this work.

2 PRODUCTS

.1 General

- .1 The system shall integrate the operation of intelligent building management controllers distributed into the network.
- .2 Provide web based access. Two Ethernet connections for communication shall be provided by the Electrical Division.
- .3 The DDC System shall be generally comprised of the following devices to achieve the control functions described in this section:
 - (1) Distech Controls programmable controllers.
 - (2) Network repeaters as required by network lengths.
 - (3) Control relays.
 - (4) Control dampers and valves.
 - (5) Sensors, actuators and other input/output devices.
- .4 Controllers shall execute the application programs, calculations, and commands to provide the control function specified for that unit. Each controller shall include its own micro-computer controller, power supply, input/output modules, termination modules and real time clock.
- .5 Controllers shall be capable of full control functionality and alarm reporting independently or as a part of the DDC network.
- .6 The system shall be stored in flash ram so no batteries are required.
- .7 Each control device shall be modular and expandable to provide additional inputs and outputs and control functionality for that device
- .8 Each controller shall be able to transfer and receive data via the network for performance of control functions.
- .9 The system shall be modular, permitting expansion by adding hardware and software without changes in communication or processing equipment.
- .10 The complete system shall be capable of communication over a LonWorks and/or BACnet network.
- .11 The controllers shall monitor the status of all overrides and include this information in logs and summaries to inform the operator that automatic control has been inhibited.
- .12 Controllers shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment and provide both local and remote annunciation of any component failures.
- .13 Controllers shall activate an orderly shutdown of their operation in the event of loss of normal electrical power. Non-volatile memory shall be incorporated for all controller configuration data. The controllers shall automatically resume full operation without manual intervention.
- .14 The controllers shall have sufficient memory to support their own operating system and data bases including:
 - (1) control processes
 - (2) energy management applications
 - (3) alarm management
 - (4) trend data
 - (5) operator input/output
 - (6) remote communications
 - (7) manual override monitoring
- .15 Controllers shall incorporate the following software features:

- (1) Energy management:
 - (a) Time of Day Scheduling
 - (b) Calendar Based Scheduling
 - (c) Holiday Scheduling
 - (d) Optimal Start and Stop
 - (e) Demand Limiting
 - (f) Heating/Cooling Interlock
 - (2) Alarm Management:
 - (a) Alarm Management shall be provided to monitor, buffer and direct alarm reports to operator devices and memory files. The controllers shall perform alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost.
 - (b) All alarm or point change report shall include the points' English language description and the time and date of occurrence.
 - (c) The user shall be able to define the specific reaction for each point, the priority level (3 in total) and ability to inhibit alarm reporting for each point.
 - (d) The user shall be able to define conditions under which point changes need to be acknowledged by an operator and logged for analysis at a later date.
 - (e) The user shall be able to print, display or store a unique 60 character alarm message to more fully describe the alarm condition or direct operator response. The message shall be customizable to describe each individual alarm.
 - (f) In web access applications only critical alarms shall initiate a call to a remote operator device, otherwise call activity shall be minimized by time stamping and saving reports until a manual request is received or until the buffer space (minimum 50 alarms) is full.
 - (3) Trend Logs:
 - (a) Controllers shall provide an automatic roll-over trend log, which stores records up to an operator-selected number at an operator-selected sampling rate and then overwrites the oldest record with each new record.
 - (b) Sample intervals shall be from 1 minute to 24 hours.
 - (c) Provide graphical and tabular displays
 - (4) Runtime Totalization:
 - (a) The controllers shall automatically accumulate and store runtime hours for binary points with a sampling resolution of 1 minute. The user shall have the ability to define a warning limit to trigger maintenance or user-defined messages.
 - (5) Event Totalization:
 - (a) Controllers shall have the ability to count events (such as on/off) and store up to 10 million events before reset with a user-defined limit used to trigger a user-defined message.
 - (6) Custom Programming:
 - (a) The controllers shall permit user defined custom control processes based on:
 - (i) any system measured data or status
 - (ii) any calculated data
 - (iii) any results from other processes
 - (iv) Boolean logic
 - (b) The custom processes may be triggered by:
 - (i) Time-of-day
 - (ii) calendar date
 - (iii) events (point alarm etc.)
- .16 The control strategy for each control loop shall be performed by software within the controller. The sequence of events required for each control loop is described for each system in the control sequence.
- .17 Outdoor air temperature indication shall be available at each controller as an integral part of the control strategies for that controller. Should the network transmission of the common outdoor air temperature (or any other common value) fail, then each controller shall use the last good value received.
- .18 Controls and Requirements for VVT Systems
- (1) Where VVT controls are specified, units are to operate as part of a Variable Volume/Variable Temperature System complete with all necessary controls including zone dampers, temperature sensors, static pressure sensor probes and bypass damper.

- (2) There shall be no zone controllers for the room control. Control shall be from a designated programmable controller for each air handling unit to ensure information transfer is fast enough to react to the changes in the environment.
 - (3) The VVT Control System shall include but not be limited to individual DDC room/zone sensors, corresponding zone dampers, bypass damper, connecting communication network, all required duct sensors, all required relays and other required control components and algorithms for complete control of the HVAC system according to the sequence of operation.
 - (4) Each VVT system shall be capable of operating as a stand alone system. Note that each VVT rooftop unit shall have its own designated controller that controls all zones directly in order to keep information exchange quicker and more efficient.
- .2 Network Architecture
- .1 The controllers on the local network shall communicate via a two wire LonTalk TP/FT-10 network.
 - .2 The control network shall be able to expand to match the requirements of the facility, including any future building additions.
 - .3 The control network shall be able to support a total developed length of 305 meters without using a network repeater.
- .3 Control Panels
- .1 Control panels shall be fully enclosed cabinets with all steel construction. Cabinets shall have a hinged door with locking latch or bolt-on cover plate. All cabinet locks shall be common keyed. Cabinets shall be finished with two coats of paint.
- .4 Temperature Sensors
- .1 Provide thermistor temperature sensors, not requiring transmitters, to measure temperature.
 - .2 Accuracy shall be +/-0.2°C from 0 to 70°C.
 - .3 Space sensors in occupied areas shall be Greystone TE200 series, type AE or Distech Smart Comfort SO having an integral push button for unoccupied override and an integral slider to adjust set point (LED display not required).
 - .4 In corridors and where noted on the drawings, provide stainless steel plate type sensors (push button override and LED display not required), Greystone TE200 series, type AS or equal.
 - .5 Duct temperature sensors shall be Greystone TE200 series, type B or equal having a stainless steel probe length to suit application and ABS enclosure. Duct averaging temperature sensors shall be Greystone TE200 series, type FD or equal having an element length to suit application, copper probe and ABS enclosure.
 - .6 Immersion temperature sensors shall be Greystone TE200 series, type C or equal having a ¼" OD stainless steel probe, 4" long and ABS enclosure. Immersion sensors shall be complete with thermowells. Thermal conductive compound shall be added inside the thermowell to provide optimum thermal transfer from the fluid to sensor. Stainless steel thermowells shall be used for steel pipe and brass thermowells shall be used in copper pipe.
 - .7 Outdoor temperature sensors shall be Greystone TE200 series, type F or equal having an ABS gasketed cover. A thermal radiation cover shall limit the sensor to solar radiation exposure.
- .5 Carbon Dioxide Sensors
- .1 Sensors shall Greystone CDD series or equal having the following features:
 - (1) 0-2000 ppm factory default detection range, field adjustable.
 - (2) Non-dispersive infrared sensing element with self-calibration algorithm.
 - (3) Guaranteed 5 year calibration interval.
 - (4) Powered by either AC or DC source.
 - (5) Accuracy: within 50 ppm or 3% of reading (whichever is greater).
 - (6) Operating humidity range: 0-95% RH.
 - (7) Operating temperature range: 0 to 50°C or greater.
 - (8) Stability: less than 2% full scale in 15 years

- (9) Response time: less than 2 minutes for 90% step change.
- .2 Duct mounted sensors shall be complete with ABS enclosure complete with sampling tube.
- .3 Space mounted sensors shall be executive space type without LCD display.
- .6 VVT System Dampers and Operators
 - .1 Rectangular dampers shall be Nailor 1010 or equal, parallel blade type complete with blade and edge seals. Use low profile dampers for heights less than 12" (300 mm). Dampers with heights less than 10" (250 mm) shall be single blade.
 - .2 Round dampers shall be Nailor 1090 or equal complete with blade gaskets and mounting bracket.
 - .3 Actuators shall be Belimo LMB24-SR-T or equal, proportional control, non-spring return, direct coupled, 24 V for 2-10 VDC or 4-20 mA, 45 in-lb torque, suitable for a maximum damper size of 6 square feet.
- .7 Water Control Valves
 - .1 Heating and cooling control valves shall be Belimo CCV series characterized ball valves, complete with chrome plated brass trim and NPT female pipe connections. Radiation valves shall be complete with non-spring return modulating actuators. Control valves for coils heating a portion of outdoor air shall have spring return modulating actuators.
 - .2 Control valves shall be sized to provide approximately one half the circuit branch pressure drop to obtain good modulation control but they shall be no smaller than two pipe sizes less than the pipe they are installed in.
 - .3 Control valves in contact with domestic water (domestic flush valve) shall be Belimo HTCCV high temperature characterized ball valve with stainless steel ball and stem, NPT female pipe connections and TFX24 spring return to closed position actuator.
- .8 Differential Pressure sensors
 - .1 Differential pressure sensors shall be provided for liquid or air differential pressure applications. The differential pressure range shall be selected to match the application. Select materials suitable for the measured variable, i.e.: water or air, and to withstand a minimum of two times the maximum pressure of the highest pressure range.
 - .2 Each sensor shall be provided with an industry standard, 0 to 10 Vdc output signal mounted at the sensor. The transmitter and sensor shall have a combined accuracy and repeatability of 1.0% of the differential pressure range. A pushbutton zero adjustment shall be provided.
- .9 Freezestats
 - .1 Freezestats shall be complete with a vapour filled 20 foot bulb and 4 foot capillary. Wire freezestats to shut down the respective fans should temperature over any 12 in. of sensor length drop below the adjustable setpoint (2°C). Freezestats shall have manual reset.

3 EXECUTION

- .1 Installation
 - .1 All controllers and components in the system and on the network shall be installed according to manufacturer recommendations, general installation standards for digital controls and in accordance with the approved shop drawings.
 - .2 Locate room sensors in the locations shown on the mechanical drawings. All sensors shall be mounted at barrier free height (3'-11" (1175 mm) above finished floor).
 - .3 All control components for off site system access shall be located where noted on the drawings. The Electrical Contractor shall provide all required connections / cabling for off site access to the web access components.

- .4 All programmable controllers, web access components, relays and other control components shall be located within control panels. Control Panels shall be wall mounted and shall be located within suspended ceiling spaces or other locations approved by the Consultant.
- .5 The Electrical Contractor will provide hand-off-auto switches in all starters controlled by the BAS.
- .6 The Electrical Contractor will provide dedicated 120 VAC, 15 ampere power circuits wired to junction boxes on each floor for controls transformers.
- .7 The supply of all motorized temperature control dampers complete with actuators shall be by this Section, except for dampers and actuators supplied with packaged air handlers. All dampers shall be installed into the duct system by the HVAC Trade complete with necessary duct transitions, access doors, etc. The Temperature Control Contractor shall be responsible for the actuators and all coordination with the HVAC Contractor.
- .8 The supply of all automatic control valves shall be by This Section. All valves shall be installed into the piping system by Plumbing Trade complete with necessary fittings, etc. The Temperature Control Contractor shall be responsible for all coordination with the Plumbing Contractor.
- .2 Generally duct mount carbon dioxide sensors shall be used where specified for air handling units; but, for gyms and single zone libraries, a wall mount carbon dioxide sensor shall be mounted next to the room temperature sensor.
- .3 All carbon dioxide levels which are measured by the carbon dioxide sensors shall be made available to the Owner in the form of trend logs. Record readings at 10 minute intervals and keep them for at least 30 days.
- .4 Freezestats shall be installed so that their sensing element runs horizontally across the coil face (not diagonally) with no more than 12" vertical drops at the outside coil frame. The full face of the coil shall be covered with no horizontal runs being more than 12" apart. The top and bottom horizontal run shall be within 6" of the coil frame. If more than one freezestat is required they shall be wired in series in order to detect a low temperature in portion of the coil. The sensing elements shall be firmly secured in place to avoid vibration without added air restriction.
- .5 System Start-up and Acceptance
 - .1 Upon completion of installation, test, adjust and calibrate controls provided under this Section.
 - .2 On system completion, a demonstration of complete system operation shall be made to the Owner's authorized representative and Consultant.
 - .3 The Consultant shall verify through the Owners representatives that the entire system is complete and operating to the satisfaction of the Owner before final acceptance is approved.
- .6 Training
 - .1 The Contractor shall provide competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the system installed rather than a general training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. All training shall be held during normal work hours of 8:00 a.m. to 4:30 p.m. weekdays as follows:
 - .2 Provide 4 hours of training for Owner's operating personnel. Training shall include:
 - (1) Explanation of drawings, operations and maintenance manuals
 - (2) Explanation of web access program
 - (3) Explanation of adjustment procedures
 - (4) Trend Analysis
- .7 Identification
 - .1 Provide system identification and provide nameplates identifying the following (nameplates shall be keyed to the wiring diagrams):

- (1) Duct mounted sensors.
 - (2) Control panels (identify as to equipment / systems controlled). Each panel shall include an as-built drawing showing all the connected control points.
 - (3) Identify the emergency ventilation control switch with 'GLOBAL ROOFTOP UNIT CONTROL - VENTILATION LOCKOUT'
- .8 Testing and Balancing
- .1 During the system testing and balancing by the Testing and Balancing Agency, demonstrate the operation of all controls. During balancing procedures, set controls to a fixed mode (bypass damper locked fully closed and all zone dampers locked fully open) to prevent any changes during the balancing procedure.
 - .2 To ensure excessive noise is not generated by the VVT systems, the following shall be performed:
 - (1) For each VVT system, the Test and Balance Agency shall measure the static pressure in the main duct at the location of the bypass damper using a manometer when the system has been stabilized (all zone dampers are full open and the bypass damper is full closed). This information shall be given to the Temperature Control Contractor for verification that the VVT system is properly calibrated.
 - (2) For each VVT system, 10% of the dampers shall be set to the full open position and 90% shall be set at their minimum position (fully closed). When operating with these damper positions, the static pressure in the main duct at the location of the bypass damper shall again be measured by the Test and Balance Agency using a manometer to ensure it remains at the value measured when in the stabilized mode. This information shall be given to the Temperature Control Contractor for verification that the VVT system is operating correctly and is properly calibrated.
- .9 Electrical Wiring
- .1 Control transformers for the building automation / VVT temperature control systems shall be supplied and wired by the Temperature Control Trade from 120 V power sources in junction boxes provided by the Electrical Contractor. (At least one at each end of each floor accessible above ceiling tile in a corridor). All low voltage wiring (below 50 V) to the building automation / VVT temperature control systems shall be by the Temperature Control Contractor.
 - .2 The electrical contractor will rough-in thermostats in new concrete block walls.
 - .3 All wiring shall be installed to the standards specified in the Electrical Division.
 - .4 Use Echelon recommended orange jacket cable for all network wiring.
 - .5 Run all wiring in EMT conduit where exposed, where running within concrete block walls and where required by the Ontario Electrical Code (conduit supplied and installed by the Temperature Control Contractor). Plenum rated cable shall be used in return air ceiling plenums.
 - .6 Where wiring runs through Corridor suspended ceiling spaces, run in wall hooks where possible. The wall hooks shall be provided by the Electrical Contractor where indicated on the electrical drawings.
 - .7 Control relays necessary for BAS operation shall be provided by the Temperature Control Contractor but all contactors and their power supplies handling power wiring to the equipment shall be by the Electrical Contractor.
- .10 General Requirements for VVT Systems
- .1 Each VVT system shall be capable of maintaining an independent setback schedule. If any over-ride pushbutton in the associated system is activated, the complete VVT system shall reset to occupied mode for a pre-set time period. At the end of the override time period, setback mode will resume.
 - .2 Each zone thermostat shall be capable of maintaining independent comfort setpoints, adjustable by the zone occupants. The upper and lower limits of the permissible setpoint range shall be adjustable by the operator.
 - .3 When the HVAC unit is not in the heating or the cooling mode, the system shall go to ventilation mode. Ventilation mode is automatically sequenced every 20 minutes to avoid stale air in the space. The duration of ventilation mode is 5 minutes, after which the system resumes heating / cooling mode as required.

- .4 Zone damper control shall be proportional modulation, not two- position control. Each zone thermostat shall be capable of initiating a heating or cooling mode. Averaging zone systems are not acceptable.
- .5 The pressure control system must display duct static pressure and modulate the bypass damper or supply fan speed to maintain the desired system static pressure. During changeover from heating to cooling or cooling to heating the bypass controller will take control of all dampers in order to purge the duct system of extreme temperature air. Systems that use a time delay during system mode changeover are not acceptable.

4 Sequence of Operation

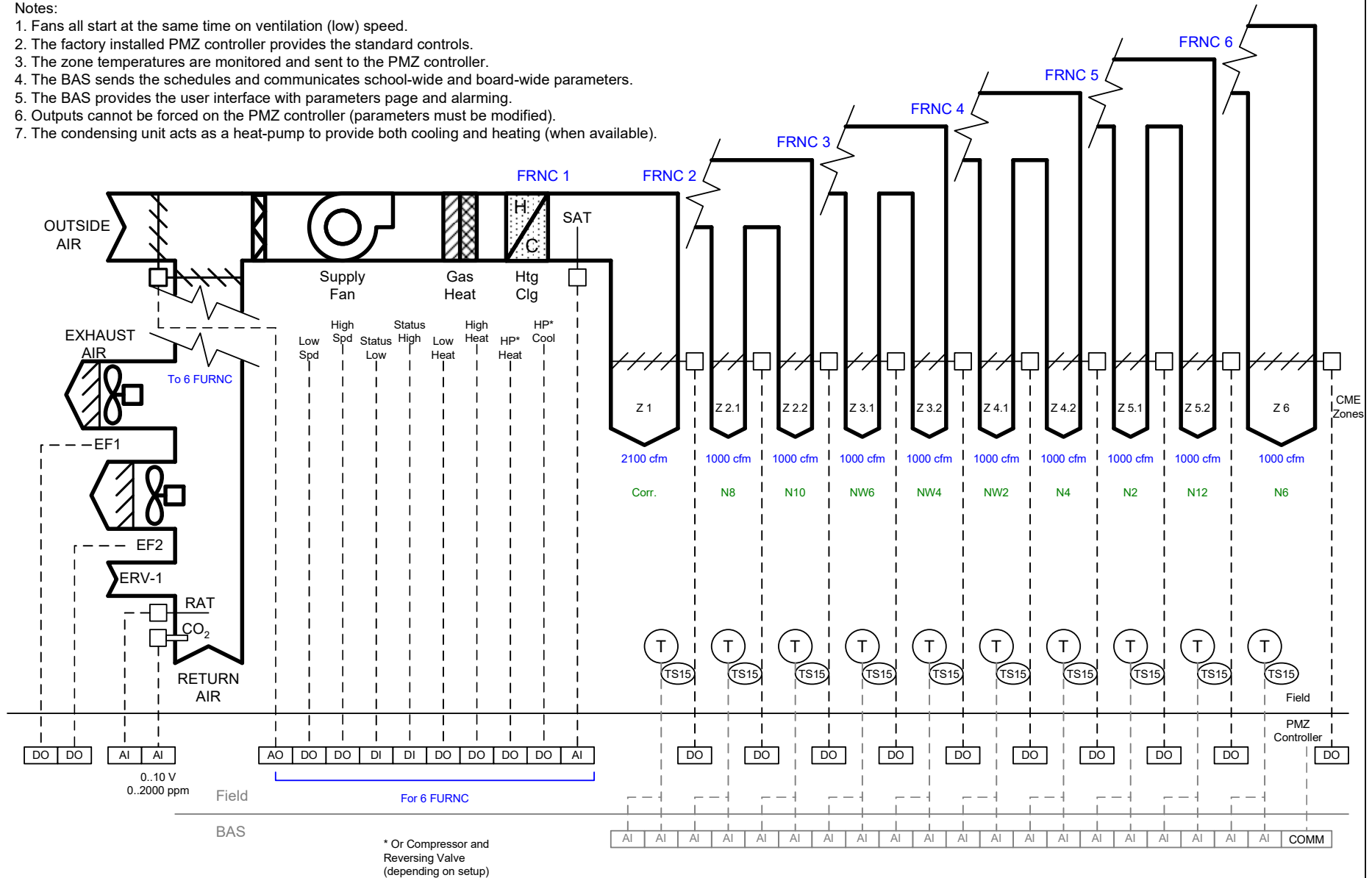
.1 General:

- .1 All setpoints shall be adjustable.
 - .2 Outdoor air temperature shall be broadcasted to all controllers.
 - .3 A new outdoor air sensor shall be provided on a different north face and the minimum of this sensor and the original will be used for this building.)
 - .4 Heating mode: Heating is enabled between October 15 and April 15 or if the outdoor air temperature is below 10°C. This heating mode is used in all controllers for the building.
 - .5 Cooling Mode: Mechanical cooling is enabled if the outdoor air temperature is above 14°C.
 - .6 Carbon Dioxide Damper Override: In any air handling system with a return air or room air carbon dioxide sensor, it shall override the minimum position of the outdoor air damper during occupied mode. It shall override the minimum outdoor air damper between 0 and 40 % as the carbon dioxide varies between 1000 and 1200 ppm. All limit controls shall take priority to maintain safe supply air temperatures. An alarm shall be generated if the carbon dioxide level is higher than 1700 ppm or lower than 200 ppm.
 - .7 Occupancy mode shall be determined by a weekly schedule with an annual holiday schedule. Each system shall have this schedule but there shall be provision for operating under a general (to the building) schedule as well. An adjustable parameter shall be available to select the local or general schedule for each system.
 - .8 Lead/lag: Devices designed for lead lag operation shall operate in automatic lead/lag mode to equalize run time. If the lead unit fails the lag shall automatically start and an alarm shall be generated. The lead unit shall be advanced through the series of devices in sequence every Tuesday at noon.
- .2 See the graphical sequences at the end of this specification.

END OF SECTION

Notes:

1. Fans all start at the same time on ventilation (low) speed.
2. The factory installed PMZ controller provides the standard controls.
3. The zone temperatures are monitored and sent to the PMZ controller.
4. The BAS sends the schedules and communicates school-wide and board-wide parameters.
5. The BAS provides the user interface with parameters page and alarming.
6. Outputs cannot be forced on the PMZ controller (parameters must be modified).
7. The condensing unit acts as a heat-pump to provide both cooling and heating (when available).

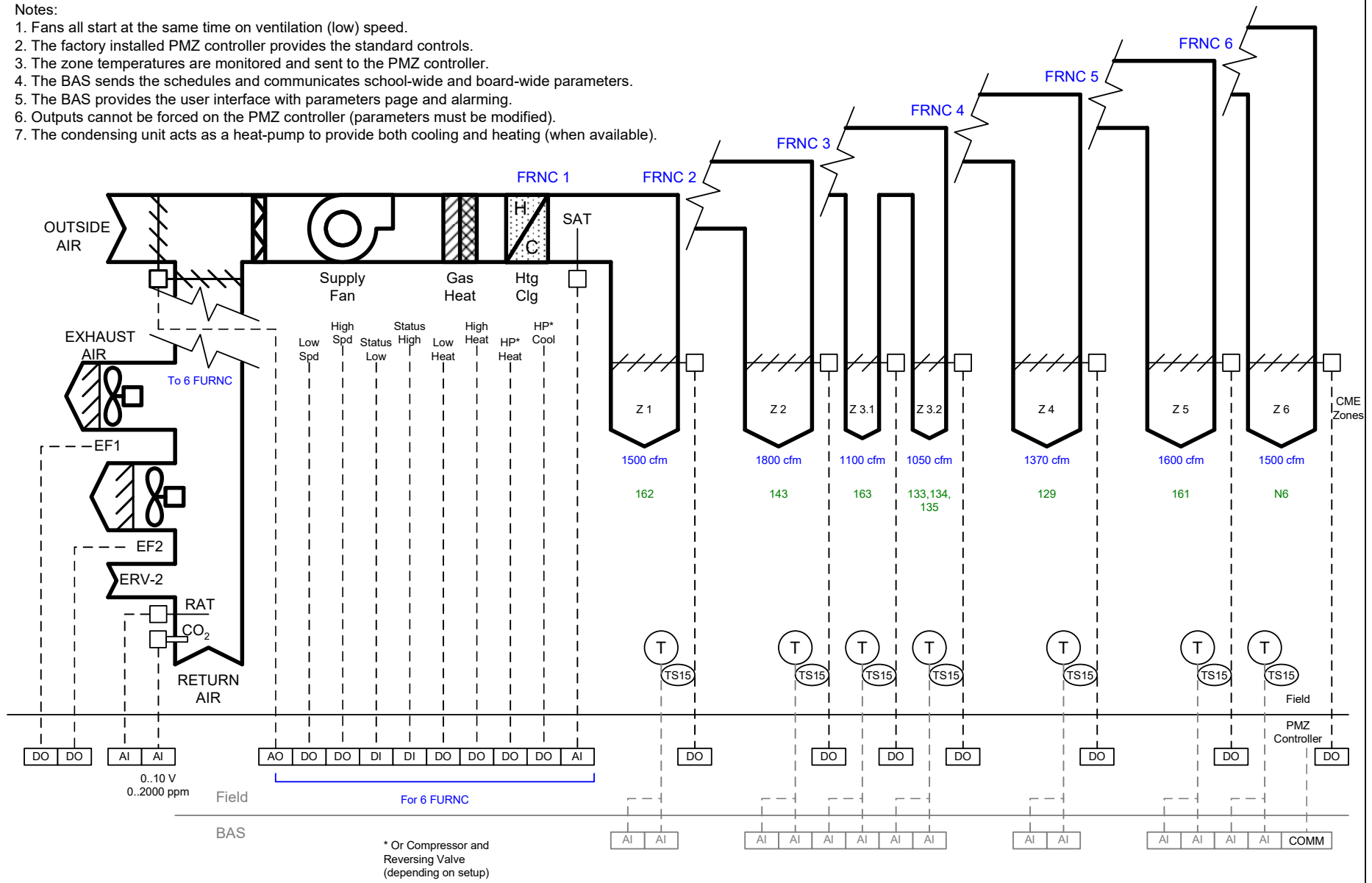


* Or Compressor and Reversing Valve (depending on setup)

Job #:	Owner:	Drawn By:	Title: CME Multizone MZ1 Fan System	1
	Job Name: Park Manor PS Phase 2 Renovations	Waterloo Region District School Board		

Notes:

1. Fans all start at the same time on ventilation (low) speed.
2. The factory installed PMZ controller provides the standard controls.
3. The zone temperatures are monitored and sent to the PMZ controller.
4. The BAS sends the schedules and communicates school-wide and board-wide parameters.
5. The BAS provides the user interface with parameters page and alarming.
6. Outputs cannot be forced on the PMZ controller (parameters must be modified).
7. The condensing unit acts as a heat-pump to provide both cooling and heating (when available).



Job #:	Owner:	Drawn By:	Title: CME Multizone MZ2 Fan System	2
	Job Name: Park Manor PS Phase 2 Renovations	Waterloo Region District School Board		

General

The new multizone unit comes with factory installed and programmed controls. The BAS monitors the zone temperatures and sends them and weekly and holiday schedules via BACnet MS/TP to the multizone controls.

Unoccupied Mode

The supply fans are off, mixing dampers are in the 0% outside position, the heating and DX cooling are disabled. If the coldest space temperature falls below the unoccupied heating setpoint (16/18°C) or the warmest space temperature exceeds the unoccupied cooling setpoint (30/28°C), all the fans will cycle on with the outside air dampers closed. The furnaces where unoccupied temperature control is required will cycle to maintain setpoint. If the override pushbutton is pressed on any room sensor, the system will revert to the occupied mode for a period of 2 hours (adjustable).

Occupied Mode

An optimum start routine calculates the required start time for the system. During morning warm-up and cool-down, the minimum outside air position is set to zero. The supply fans run continuously. The fans run at ventilation (low) speed until heating or cooling is required, then they run at high speed.

The outdoor air damper opens to the minimum outdoor air setting. The return air CO₂ sensor will increase the minimum outside air setpoint as the measured CO₂ level increases between 1000 and 1200 ppm.

Each furnace fan goes to high speed when heating or cooling is required.

When the outside air temperature exceeds the global heating disable setpoint, all heating is disabled.

The condensers act as heat-pumps. An outdoor air temperature setpoint is determined from energy consumption measurements. Above this setpoint, initially set at -10°C, the heating is supplied by the heat-pumps, but below this setpoint the gas heating is used.

Cooling is provided by opening the outside air dampers for free cooling when outdoor air conditions permit, otherwise the mechanical cooling runs.

Dehumidification is provided when the return air relative humidity is higher than setpoint (50% RH).

When the outside air temperature falls below the global DX cooling disable setpoint, or when the warmest zone deviation is less than 1°C, mechanical cooling is disabled.

The outdoor air flow rate is calculated according to each fan speed and outdoor air damper position and this cycles on the exhaust fans to balance the air flow.

Zone space temperature sensors cycle their respective zone damper to maintain setpoint. An adjustment of +/-1.5°C is provided at each room temperature sensor. The default space temperature setpoint is raised 1°C when DX cooling is enabled.

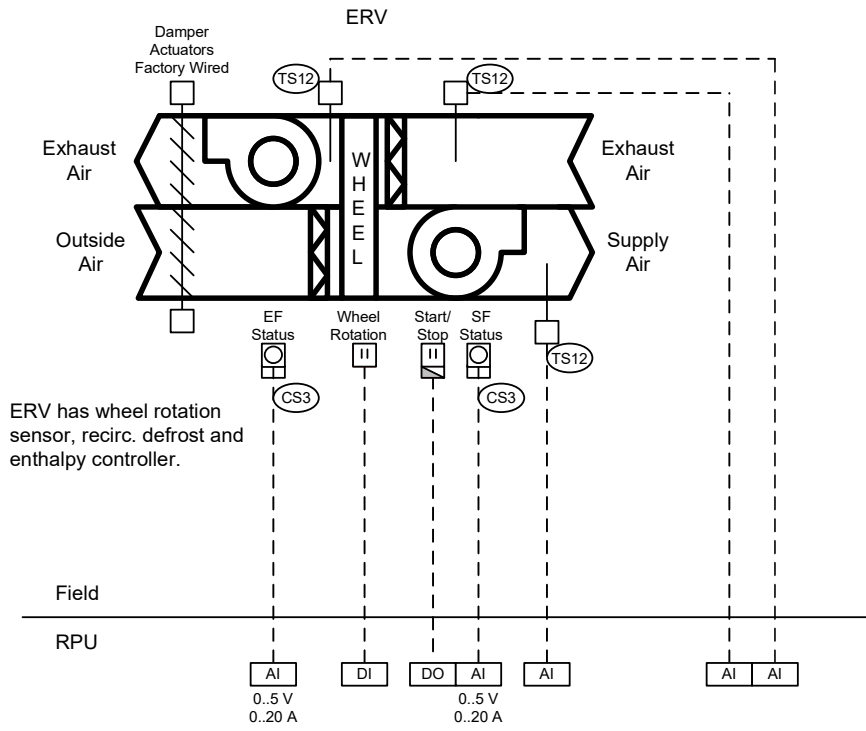
Limits & Safeties

- 1) The mixed damper positions are limited based on outside air temperature to prevent excessive amounts of cold outside air on system start-up.
- 2) The DX compressors have minimum off-time of 5 minutes.
- 3) The supply air temperature sensors act as a low limit to disable DX cooling or close the outdoor air if the temperature falls below 1/5°C (auto-reset, 1 minute delay before shutdown, 5 minute delay before restart).

Alarms

- 1) Supply air temperature too low (8/10°C) or too high (60/55°C).
- 2) Room temperature or return air temperature to low (14/15°C) or too high (38/36°C).
- 3) Supply fan status does not match the output signal.
- 4) Software freezestat tripped.
- 5) Return air CO₂ too high (1800/1750 ppm) or too low (250/300 ppm).

	Job #:	Owner:	Drawn By:	Title: CME Multizone Fan System Sequence of Operation	3
	Job Name: Park Manor PS Phase 2 Renovations	Waterloo Region District School Board	Revision Date: February 3, 2022		



SEQUENCE OF OPERATION

Unoccupied Mode

The exhaust fan is off, supply fan is off, heat wheel is off and the dampers are closed.

Occupied Mode

The supply and exhaust fans run continuously when the associated rooftop unit is operating and the ventilation time schedule is on. The heat wheel operates from internal controls.

Limits & Safeties

- 1) The unit has internal frost controls (exhaust fan stops, supply fan recirculates air).
- 2) The supply air temperature sensor acts as a software freezestat (-1/5°C, 3 minute delay, auto reset after 5 minute delay).
- 3) The fans stop on a fire alarm condition.
- 4) If the mixed air damper position exceeds 30% outside air on HVAC unit, the ERV supply fan stops.
- 5) The exhaust air temperature cycles the supply fan to maintain the exhaust air temperature at +1°C.

Alarms

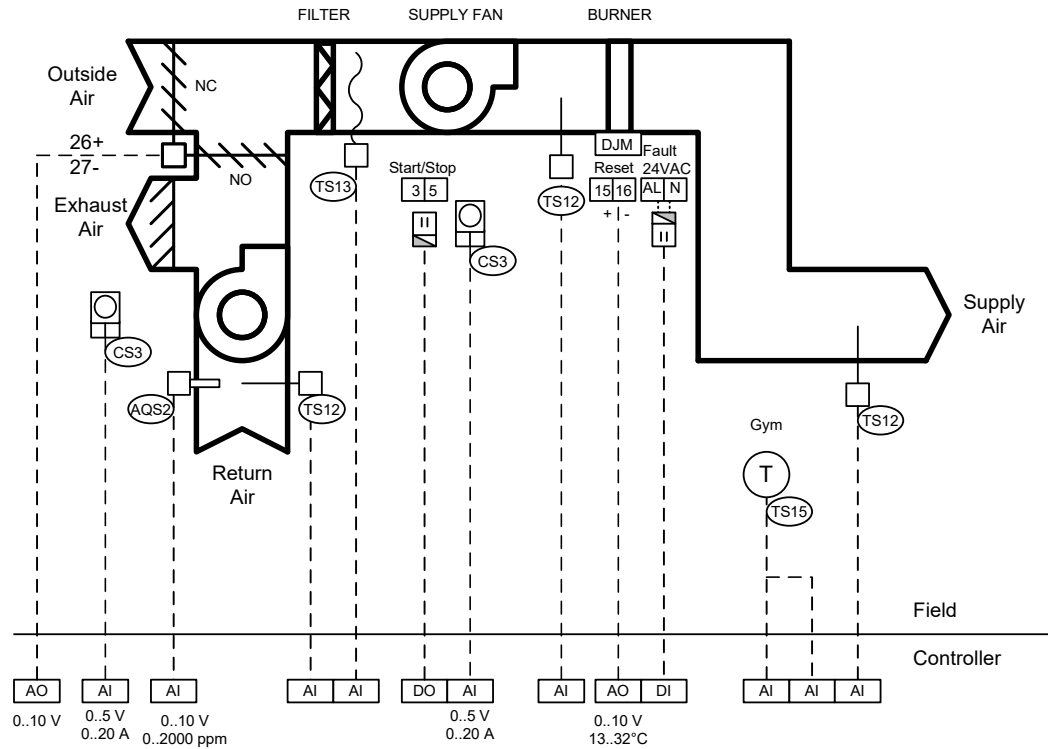
An alarm will be generated upon the following conditions:

- 1) Supply fan or exhaust fan in incorrect state.
- 2) Supply air temperature too high (35/33°C) or too low (1/3°C).
- 3) Return air temperature too high (40/38°C) or too low (14/15°C).
- 4) Exhaust air temperature too high (40/38°C) or too low (-10/-8°C)..
- 5) Fan runtime exceeded weekly setpoint.

Two Systems As Shown				
UNIT	Air (cfm)	Cook Model	Control	Notes
ERV-1	2220	ERV-5500		Serves MZ-1
ERV-2	2075	ERV-5500		Serves MZ-2

	Job #:	Owner: Waterloo Region District School Board	Drawn By:	Title: Energy Recovery Ventilators	4
	Job Name: Park Manor PS Phase 2 Renovations		Revision Date: February 3, 2022		

Engineered Air DJE-60/O Rooftop Unit



One System As Shown					
Unit	CFM	HP	Burner Rise	Control	Notes
HV-1	3800	7.5	30°C	TBD	VFD on SF & RF?

Notes
1) Install and wire Eng. Air discharge air sensor.

SEQUENCE OF OPERATION

Unoccupied Mode

The supply fan is off, the mixing dampers are in the 0% outside air position and the heating is off. The fan cycles on a call for unoccupied heating or cooling. If the override pushbutton is pressed, the system will switch to the occupied mode for 2 hours (adjustable).

Occupied Mode

An optimized start routine is provided for heating. During morning warm-up the outside air minimum position is set to zero. The supply fan runs continuously. The room temperature sensor modulates heating (resets the setpoint of the Eng. Air discharge air controller) in sequence with the mixing dampers (for free cooling) to maintain setpoint. Local setpoint adjust (+/- 2°C) is provided.

Limits & Safeties

- 1) If the outside air temperature exceeds the global free cooling setpoint, the mixing dampers return to minimum outside air position.
- 2) The maximum amount of outside air is limited based on the outside air temperature to prevent excessively low supply air temperatures during startup.
- 3) Mixed air temperature sensor acts as a low limit to ensure temperature does not fall below setpoint.
- 4) The Eng. Air unit has an integral low limit auto bypass set at 4.4°C.
- 5) The Eng. Air unit has a blower delay-on timer.
- 6) The supply air temperature sensor acts as a software freezestat and will shut down the system if the temperature falls below 2/5°C (auto reset, 3 min. delay before shutdown, 5 min. delay before reset).
- 7) The supply air temperature sensor acts as a high limit, and will shut down heating if the temperature exceeds 65°C.
- 8) The CO₂ sensor will increase the amount of minimum outside air as the CO₂ increases from 1000 to 1200 ppm.
- 9) The outside air dampers close when ventilation lockout is engaged.

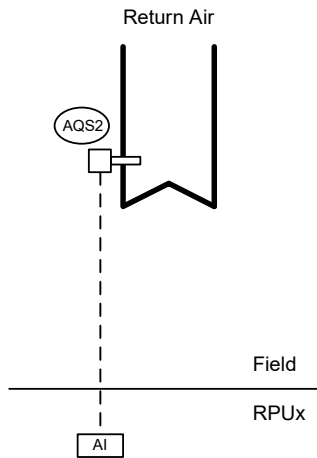
Alarms

An alarm will be generated upon the following conditions:

- 1) Fan status does not match start/stop signal.
- 2) Supply air temperature too high (65/60°C) or too low (7/9°C).
- 3) Space temperature too high (38/36°C) or too low (14/15°C).
- 4) Mixed air temperature too high (50/48°C) or too low (5/7°C).
- 5) Return air temperature too high (42/40°C) or too low (14/15°C).
- 6) DJM Fault (flame failure or low limit).
- 7) Supply fan weekly runtime has exceeded runtime setpoint.
- 8) Software freezestat tripped.
- 9) CO₂ too high (1700/1600 ppm) or too low (250/300 ppm).

	Job #:	Owner: Waterloo Region District School Board	Drawn By:	Title: HV-1 Gym Air Handler	5
	Job Name: Park Manor PS Phase 2 Renovations		Revision Date: February 3, 2022		

DEMAND CONTROLLED VENTILATION



1 System
As Shown

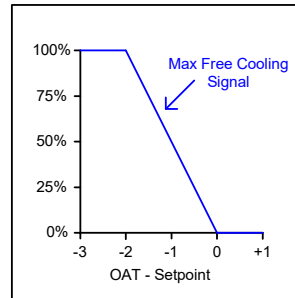
SEQUENCE OF OPERATION

The CO₂ sensor acts as a high limit and will increase the amount of minimum outside air to a maximum of 40% as the CO₂ level increases from 1000 ppm to 1200 ppm. The normal mixed air temperature limits apply. An alarm is generated if the CO₂ is too low (250/300 ppm) or too high (1700/1600 ppm).

Add to existing units:
AC1 relabel as "HVAC-1" (Office)

FREE COOLING SETPOINT

The average outdoor air relative humidity is sent from the Vista Server to the Global Input for this school where the Free Cooling Setpoint is calculated.



Detail 1

SEQUENCE OF OPERATION

Free cool when OAT < minimum(23, 29.4°C - Ø/7.43) where Ø is the average relative humidity in %RH. The free cooling signal is 100% when the outdoor air temperature is more than 2°C less than the free cooling setpoint. It drops linearly as the outdoor air temperature increases from 2°C less than the free cooling setpoint to 0% at the setpoint. This free cooling signal is used in each mixed air damper controller as the maximum the outdoor air dampers can open.

STAND-BY VENTILATION OCCUPANCY SCHEDULE

Add to Existing
Menta Programs

Weekly Schedule
on Main Graphic

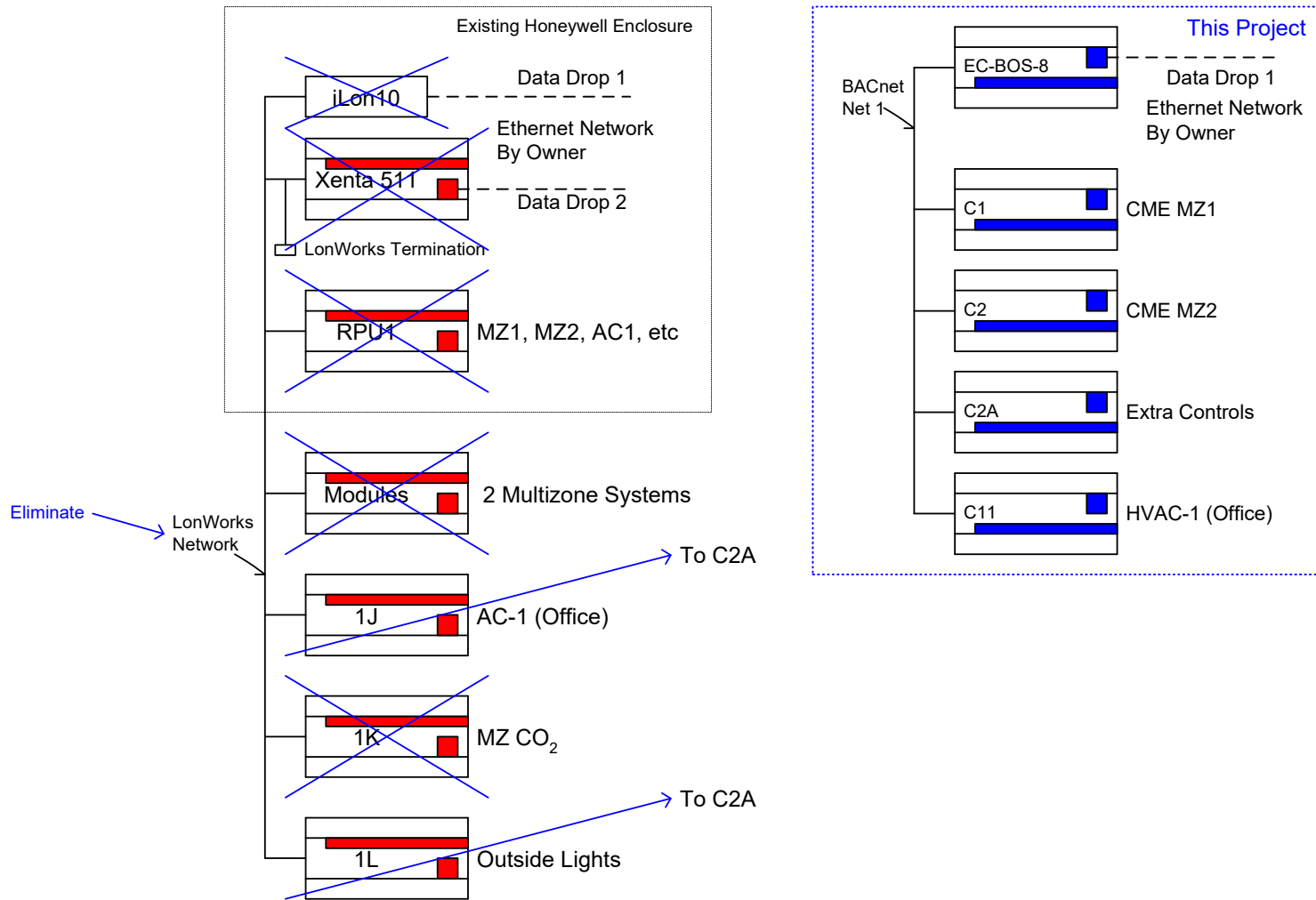
SEQUENCE OF OPERATION

Minimum outdoor air damper position is 0% even during occupied periods unless the Minimum Outdoor Air Schedule for the school is in Occupied mode. Each unit has an 'opt-out' parameter so that it can run with an individual minimum outdoor air schedule.

Add to existing units:
HVAC-1 (Office)

	Job #:	Owner: Waterloo Region District School Board	Drawn By:	Title: Miscellaneous Controls	6
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LonWorks Communication Schematic



	Job #:	Owner: Waterloo Region District School Board	Drawn By:	Title: Miscellaneous Controls	7
	Job Name: Park Manor PS Phase 2 Renovations		Revision Date: February 3, 2022		

1 General

1.01 Summary

.1 Section Includes

.1 Circuit breaker retrofit installations. The existing low voltage switchboard is equipped with low voltage metal enclosed fusible disconnect switchboard structures of an obsolete vintage with little to no product support except unreliable retrofitted replacements, or the available product support is not available in the required device size.

.2 Related Requirements

.1 Section 26 28 16.02 – Molded Case Circuit Breakers.

1.02 References

.1 Execute the work in accordance with the requirements of Ontario Electrical Safety Code, the Canadian Electrical Code, the Ontario Building Code and all Authorities Having Jurisdiction (AHJ).

1.03 Submittals

.1 Provide detailed drawings of planned switchboard modifications after internal survey has been completed.

.2 Submit circuit breaker and accessory submittals in accordance with Section 26 28 16.02.

.3 Submit a detailed Method of Procedures (MOP) document that provides detailed step-by-step instructions for how the work is to be executed.

1.04 Closeout Submittals

.1 Record documentation:

.1 Exact modifications performed to the existing electrical distribution equipment.

.2 Inspection certificate from AHJ.

2 Products

2.01 Molded Case Circuit Breakers

.1 In accordance with Section 26 28 16.02.

.2 Interrupting capacity to match that of the upstream breaker.

2.02 Bussing Kits

.1 Copper, ampacity to match existing.

.2 Provide all accessories required for a complete installation.

3 Execution

3.01 Installers

.1 Installers List

.1 Bibico Electric Inc.

- .2 Commercial Switchgear Ltd.
- .3 Approved equal.

3.02 Examination

- .1 Preparation and Scheduling
 - .1 Provide 12 weeks notice to Owner's personnel, and to the Consultant, prior to scheduled power shutdown dates.
 - .2 Shutdown to occur during overnight weekend hours.
 - .3 Provide power shutdown schedule for approval by the Owner.
- .2 Survey of Internal Bussing
 - .1 During shutdown, survey the existing bussing to confirm available space for connecting the new devices.
 - .2 Coordinate site visits with circuit breaker vendors.
 - .3 Check and verify all dimensions on the job site. Exact bus orientation and configuration is to be verified by breaker manufacturer, or its representative.

3.03 Installation

- .1 Include under this tender price for bus and bucket modification costs.
- .2 Relocate existing branch circuit devices and branch feeders to allow space for new devices.
- .3 Modify existing breaker bus to accept new molded case circuit breakers.
- .4 Install new circuit breakers as indicated on the drawings.
- .5 Make good existing breaker control wiring with new breaker controls. Bring replacement to pre-replacement status.
- .6 Make good blank-off plates.
- .7 Identify all new equipment. New switchboard branch breakers to be permanently identified with etched lamacoid nameplates in accordance with Section 26 05 53.

3.04 Field Tests and Inspections

- .1 Test new devices in accordance with Section 26 28 16.02.
- .2 Employ the services of the manufacturer's representative to perform testing, verification and commissioning of new breakers, new bus bar inter-connections and overall integrity of the modified switchboard.
- .3 Provide for the costs of the Authority Having Jurisdiction to inspect and accept the work prior to re-energizing the switchboard.

3.05 System Startup

- .1 At conclusion of installation, use appropriate arc flash protection during re-energizing of the equipment.

3.06 Cleaning

- .1 Before energizing any systems, inspect and clean the inside of switchgears, duct assembly, and cabinets to ensure that they are completely free from dust and debris. Clean all polished, painted and plated work bright. Remove all debris, surplus material, and all tools. Carry out additional cleaning operating of systems as specified in other sections of this division.

End of Section

1 General

1.01 References

- .1 Division 00 and Division 01 apply to and are a part of this Section.

1.02 Application

- .1 This Section specifies requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. Where requirements of this Section contradict requirements of Divisions 00 or 01, conditions of Division 00 or Division 01 to take precedence.
- .2 Be responsible for advising product vendors of requirements of this Section.

1.03 Section Includes

- .1 Common requirements for electrical work.
- .2 Mounting heights for electrical equipment and devices.

1.04 Related Requirements

- .1 Provisions of this section apply to all sections of Division 26, Division 27, Division 28, and sections related to electrical utilities in Division 33.
- .2 Document 00 64 01 – Request for Electronic Files Form.
- .3 Section 07 60 00 – Flashing and Sheet Metal.
- .4 Section 07 84 00 – Firestopping.
- .5 Section 08 31 00 – Access Doors and Panels.
- .6 Section 09 91 00 – Painting.

1.05 Intent

- .1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter.
- .2 Leave complete systems ready for continuous and efficient satisfactory operation.

1.06 Drawings and Specifications

- .1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a ruling is to be obtained by submitting questions to the question portal. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.
- .2 All drawings and all Divisions of these specifications shall be considered as a whole, and work of this Division shown anywhere therein shall be furnished under this Division.
- .3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of conductors and wiring is not assured. Exact requirements are governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull and junction boxes, etc. necessitated by such conditions are to be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.

- .4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job.
- .5 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made at no additional cost to the Owner.
- .6 Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc. may not be shown, but where such items are required by other sections of the specifications of where there are required for proper installation of the work, such items are to be furnished and installed.
- .7 Before ordering any conduit, cable tray, conductors, wireways, raceway bus duct, fittings, etc., verify all pertinent dimensions at the job site and be responsible for their accuracy.
- .8 If obvious ambiguities or omissions are noticed when tendering refer same to the Consultant for a ruling and obtain the ruling in writing in the form of an Addendum. Claims for extras for ambiguities or omission of items brought to the attention of the Consultant after the award of a contract which, due to the nature of the ambiguity or omission, should have been brought to the attention of the Consultant during the tendering period, will not be allowed.
- .9 The drawings are performance drawings, diagrammatic, and show locations for apparatus and materials. The drawings are intended to convey the scope of work and do not intend to show Architectural and Structural details. The locations shown are approximate, and may be altered, when approved by the Consultant, to meet requirements of the material and/or apparatus, other equipment and systems being installed, and of the building. Do not scale drawings.
- .10 Provide any fitting, offset, transformation, etc., required to suit architectural and structural details but not shown.

1.07 Work Restrictions

- .1 Refer to Section 01 14 00.
- .2 Existing buildings:
 - .1 Examine the existing building, the site and surrounding areas and be fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably be ascertained by an inspection prior to Tender closing.
 - .2 All work in the existing building, other than minor works required to permit construction of the new addition, is to be performed in such a manner as to not disrupt the building operations.
 - .3 All systems are to be kept in full operation during normal building hours.
 - .4 Note that any noise generating works that disrupt the building operation shall be coordinated accordingly and carried out after/before normal operating hours.
 - .5 Cut, modify, or extend as necessary or as directed by the Consultant, the existing material or equipment to be reused or relocated to suit work under this contract.
 - .6 Existing materials and equipment which are to be used in new work shall be repaired and refinished as necessary. Provide additional new materials and components as required to facilitate reinstallation of such existing materials and equipment.
 - .7 Co-ordinate with the Owner, and refer to General Conditions.
 - .8 Do work in existing areas to best suit available space and not interfere with or obstruct use of existing facilities.
 - .9 Where disruptions of existing services are required, coordinate shut down with the Owner's operating staff and do the work at a time and in a manner mutually acceptable. Carefully schedule disruptions to keep "down time" to a minimum.

- .3 Do all cutting, patching and making good to leave in a finished condition and to make the several parts of the Work come together properly. Co-ordinate work to keep cutting and patching to a minimum.
- .4 Quality of workmanship and materials used in patching, making good and refinishing of existing construction and/or compartments shall be of a standard equal to that specified for new construction and if not specified, equal to or exceeding that of original existing work.
- .5 Prior to cutting openings, examine wall, floor and ceiling construction for buried electrical cables and pipes; and take adequate protection. Conduct cable locating tests to locate buried cables in existing work.

1.08 Allowances

- .1 Cash allowances are to be carried as indicated in Division 01 for the items indicated, each including all equipment, wiring material, labour, incidentals, profit, overhead, taxes, etc.
 - .1 Access Control and Intrusion Detection Systems.
 - .2 Integrated Telephone/Public Address (PA) System.
 - .3 Communications structured cabling.
- .2 Conduit and wireway rough-in for the above systems is part of this contract, and is excluded from the above allowances.

1.09 Substitution Procedures

- .1 Refer to Section 01 25 00 and General Provisions of the Contract.
- .2 Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.
- .3 This contractor, at his option, may use equipment as manufactured by any of the listed manufacturers. This Contractor is responsible to ensure that all items submitted by these other manufacturers meets are requirements of the drawings and specification and fits in the allocated space. The final determination of a product being equivalent is to be determined by the Consultant when a catalog number is not listed, or listed in part.
- .4 Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Consultant as described in the General Provisions of the Contract for Submittals. The Contractor bears full responsibility for the unnamed manufacturers' equipment adequately meeting the intent of the design. The Owner or the Consultant may reject manufacture at time of shop drawing submittal.
- .5 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Do not order such products until they are accepted in writing by Consultant.

1.10 Contract Modification Procedures

- .1 When submitting quotations in response to changes in the contract, quotations for electrical work are to include a breakdown of all material, including material unit rates, and labour units as indicated in the NECA Manual of Labor Units (MLU).

1.11 Coordination

- .1 Refer to Section 01 31 00.

- 2 Coordinate work with other trades to avoid conflict and to provide correct rough-in and connection for equipment furnished under other trades that require electrical connection. Inform Contractors of other trades of the required access to and clearances around electrical equipment to maintain serviceability and code compliance.
- 3 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.
- 4 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Co-operate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other trades.
- 5 Coordinate utility service outages with the owner. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.
- 6 [Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switch overs and connections. Notify Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.]
- 7 [Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.]
- 8 Co-ordinate work with all trades to ensure a proper and complete installation. Notify all trades concerned of the requirement for openings, sleeves, insets and other hardware necessary for the installation and, where work is to be integrated with the work of other trades or is to be installed in close proximity with the work of other trades, carefully co-ordinate the work prior to installation.
- 9 Working Detail Drawings
 - .1 The contractor is to prepare working detail drawings supplementary to the contract drawings, when deemed necessary by the Consultant, for all areas where a multiplicity of materials and or apparatus occur, or where the work due to architectural and structural considerations involves special study and treatment. Such drawings may be prepared jointly by all trades affected, or by the one trade most affected with due regard for and approval of the other trades, all as the Consultant will direct in each instance. Such drawings must be reviewed by the Consultant before the affected work is installed.
 - .2 Carry out all alterations in the arrangement of work which has been installed without proper study and approval, even if in accordance with the contract documents, in order to make such work come within the finished lines of walls, floors and ceilings, or to allow the installation of other work, without additional cost. In addition, make any alterations necessary in other work required by such alterations, without additional cost.

1.12 Submittal Procedures

- 1 Refer to Section 01 33 00.
- 2 Before delivery to site of any item of equipment, submit shop drawings complete with all data, pre-checked and stamped accordingly, for review by the Consultant. Indicate project name on each brochure or sheet, make reference to the number and title of the appropriate specification section, type identifier such panelboard ID or luminaire type as indicated on appropriate schedule, and provide adequate space to accommodate the Consultant's review stamp(s).
- 3 Verify field measurements and affected adjacent Work are coordinated, including passageway clearances for movement of equipment into location.
- 4 Submit shop drawings to the Consultant in electronic (PDF) format, as coordinated after award of contract. Where submittals are derived from digital originals, do not print and rescan documents; submittals made as such will be immediately rejected.
- 5 Submit a schedule of shop drawings within one week after award of contract. Group submittals by specification division as appropriate.
- 6 Shop Drawings

- .1 Submit for review, properly identified shop drawings showing in detail the design and construction of all equipment and materials as requested in sections of the specification governed by this Section.
- .2 Obtain and comply with the manufacturer's installation instructions.
- .3 Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS", stamp each copy with your company name, date each copy with the submittal date, and sign each copy. Shop drawings which are received and are not endorsed, dated and signed will be returned for re-submittal.
- .4 The Consultant will stamp shop drawings as follows:
 - .1 Reviewed ()
 - .2 Reviewed as Modified ()
 - .3 Revise and Re-Submit ()
 - .4 Not Reviewed ()
- .5 If "REVIEWED" is checked-off, the shop drawing is satisfactory. If "REVIEWED AS MODIFIED" is checked-off, the shop drawing is satisfactory subject to requirements of remarks put on shop drawing copies. If "REVISE AND RE-SUBMIT" is checked-off, the shop drawing is entirely unsatisfactory and must be revised in accordance with comments written on shop drawing copies and resubmitted. If "NOT REVIEWED" is checked-off, the shop drawing is in error of submission, not applicable for this project.
- .6 This review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor, and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the contract documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co-ordination of the work as well as compliance with codes and inspection authorities such as CSA, etc.

1.13 Safety Requirements

- .1 Refer to Section 01 35 29.
- .2 Be responsible for the safety of workers and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations prevail.

1.14 Regulatory Requirements

- .1 Refer to Section 01 41 00.
- .2 Codes and Standards
 - .1 Ontario Electrical Safety Code including all bulletins and amendments.
 - .2 Ontario Building Code and its referenced standards.
 - .3 Applicable CSA and ULC standards.
 - .4 [All work shall be in accordance with Owner's Design Guidelines.]
- .3 Permits and Fees
 - .1 Obtain and pay for all permits and fees required for the execution and inspection of the electrical work and pay all charges incidental to such permits. Submit to Electrical Inspection Department and Supply authority necessary number

of drawings and specifications for examination and approval prior to commencement of work. Arrange and pay for any special inspection of equipment specified if and when required.

- .2 Apply, pay and obtain all permits as required for the electrical work.
- .3 Upon substantial completion of your work, supply and turn over to the Consultant all required inspection certificates from governing authorities to certify that the work as installed conforms to the rules and regulations of the governing authorities.
- .4 Patents
 - .1 Pay all royalties and licence fees, and defend all suits or claims for infringement of any patent rights, and save the Owner, Architect, Project Manager and Consultants harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the work, in violation or infringement or such letters patent or rights.

1.15 References

- .1 CSA Group
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 CSA C235:19, Preferred voltage levels for AC Systems up to 50 000 V.
 - .3 Do underground systems in accordance with CSA C22.3 No. 7-15, Underground systems, except where specified otherwise.
 - .4 Ontario Electrical Safety Code (27th edition/2018), and all bulletins.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Electrical utility requirements and local applicable codes and regulations.
- .5 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .6 2012 Ontario Building Code.

1.16 Definitions

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.17 Quality Assurance

- .1 Refer to Section 01 43 00.
- .2 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.

- .3 Ensure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.
- .4 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.
- .5 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Consultant. Any unsatisfactory workmanship will be replaced at no extra cost.
- .6 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this specification. Electrical Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all electrical equipment and materials in dry locations.
- .7 Provide foreman in charge of this work at all times.
- .8 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker's Compensation, and Employer's Liability Insurance.
- .9 Governing Federal, Provincial and Municipal codes and regulations will be considered minimum standards for the work and where these are at variance with the drawings and specification, the more stringent ruling will apply.
- .10 Where any code, regulation, bylaw, or standard is quoted it shall mean the current edition including all revisions or amendments at the time of the tender.
- .11 In case of conflict, the codes and regulations take precedence over the Contract Documents. In no instance reduce the standard or scope of work or intent established by the drawings and specifications by applying any of the codes referred to herein.

1.18 Quality Control

- .1 Refer to Section 01 45 00.
- .2 Provide a full time Superintendent to oversee and coordinate all sub-trades in these divisions.

1.19 Temporary Utilities

- .1 Refer to Section 01 51 00.
- .2 Do not use any of the permanent facility systems during construction except as may be specified, or unless written approval is obtained from the Consultant.
- .3 The use of permanent facilities for temporary construction service will not affect in any way the commencement day of the warranty period.
- .4 Temporary heating during the construction period will be provided as described in Division 01.

1.20 Temporary Facilities and Controls

- .1 Refer to Section 01 56 00.
- .2 Prior to start of each work period in occupied area, install temporary protection to prevent damage to any personal property or furnishing. Coordinate with Owner's representative if any furniture must be relocated to facilitate work.
- .3 [Submit temporary protection plan to Owner's Representative for approval prior to use.]

- .4 Take necessary steps to ensure that required firefighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

1.21 Product Requirements

- .1 Refer to Section 01 61 00.
- .2 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.
- .3 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical Inspection Services, or other government agency.
- .4 Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.
- .5 Materials required for performance of work shall be new and the best of their respective kinds and of uniform pattern throughout work.
- .6 Materials shall be of Canadian manufacture where obtainable. Materials of foreign manufacture, unless specified, shall be approved before being used.
- .7 Equipment items shall be standard products of approved manufacture. Identical units of equipment shall be of same manufacture. In any unit of equipment, identical component parts shall be of same manufacture, but the various component parts comprising the unit need not be of one manufacture.
- .8 Chemical and physical properties of materials and design performance characteristics and methods of construction and installation of items of equipment, specified herein, shall be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.
- .9 Materials shall bear approval labels as required by Code and/or Inspection Authorities.
- .10 Install materials in strict accordance with manufacturer's recommendations.
- .11 Include items of material and equipment not specifically noted on Drawings or mentioned in Specification but which are necessary to make a complete and operating installation.
- .12 Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.
- .13 Unless otherwise noted, equipment and material specifications in Sections of the Specification governed by this Section are based on products of a manufacturer selected by the Consultant for the purpose of setting a standard of quality, size, performance, capacity, appearance and serviceability.
- .14 In most instances the names of acceptable manufacturers are also stated for materials and equipment, and you may base your tender price on equipment and materials produced by either the specified manufacturer or a manufacturer listed as acceptable.
- .15 For any items of equipment, material, or for any system where acceptable manufacturers are not stated, you must provide only the equipment, material or system specified.
- .16 If materials or equipment manufactured and/or supplied by a manufacturer named as acceptable are used in lieu of products of the manufacturer specified, be responsible for ensuring that the substituted material or equipment is equivalent in size, performance and operating characteristics to the specified materials or equipment, and it shall be understood that all costs for larger starters, additional space, larger power feeders, and changes to associated or adjacent work required as a result of providing materials and equipment named as acceptable in lieu of the specified product will be borne by Contractor.
- .17 In addition to the manufacturers specified or named as acceptable, the Contractor may propose alternative manufacturers of equipment and/or apparatus to the Consultant for acceptance, listing in each case a corresponding credit for each alternative

proposed, however, the tender price must be based on apparatus or materials specified or named as acceptable. Certify in writing to the Consultant that the alternative meets all space, power, design, and all other required of the specified or equivalent material or apparatus. In addition, it shall be understood that all costs for larger starters, space, power feeders, and changes to associated equipment, mechanical and/or electrical, required by acceptance of proposed alternatives, will be borne by the party making the proposal. Alternative equipment requiring greater than specified energy requirements or unduly limiting service space requirements will not be accepted.

- .18 Where a manufacturer is not listed for a particular product, it will be deemed to mean that the contractor will provide the specified manufacturer's product.

1.22 Examination and Preparation

- .1 Refer to Section 01 71 00.
- .2 Examine the existing equipment, the site and surrounding areas and be fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably have been ascertained by an inspection prior to Tender closing.
- .3 Examine work upon which your work depends. Report in writing defects in such work. Application of your work shall be deemed acceptance of work upon which your work depends.
- .4 Drawings are, in part, diagrammatic and are intended to convey scope of work and indicate general and approximate location, arrangement and sizes of equipment, piping, and similar items. Obtain more accurate information about locations, arrangement and sizes from study and coordination of drawings, including shop drawings and manufacturers' literature and become familiar with conditions and spaces affecting these matters before proceeding with work.
- .5 Where job conditions require reasonable changes in indicated locations and arrangements, make such changes with approval of the Consultant at no additional cost to the Owner. Similarly, where existing conditions interfere with new installation and require relocation, such relocation is included in work.

1.23 Cutting and Patching

- .1 Refer to Section 01 73 00.
- .2 The Electrical Contractor will be responsible for all cutting and patching required for the electrical installation. Structural members are not to be cut without the consent of the Consultant.
- .3 All cutting and patching required under Division 26, Division 27, and Division 28 shall be in accordance with Division 01. Layout such work for approval before undertaking same.
- .4 Cutting shall be kept to an absolute minimum and performed in a neat and workmanlike manner using the proper tools and equipment. Caution shall be exercised in all cutting and procedures to ensure that concealed services are not affected. Do not cut if in doubt. Request Consultant's presence to determine if concealed services exist.
- .5 Assume responsibility for prompt installation of Work in advance of concrete pouring or similar Work. Should any cutting or repairing of finished/unfinished Work be required because such installation was not done, employ the particular trade, whose Work is involved, to do such cutting and patching. Pay for any resulting costs. Layout such Work for approval before undertaking same.

1.24 Cleaning and Waste Management

- .1 Refer to Section 01 74 00.
- .2 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this trade. At the completion of this work, the electrical installation is to be left in a clean and finished condition to the satisfaction of the Consultant.
- .3 Clean and repair existing materials and equipment which remain or are to be reused.

- .4 Luminaires to be reinstalled: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.
- .5 Assume responsibility for removing tools and waste materials on completion of Work, and leave Work in clean and perfect condition.

1.25 Starting and Adjusting

- .1 Refer to Section 01 75 00.
- .2 Conduct acceptance tests to demonstrate that the equipment and systems actually meet the specified requirements. Tests may be conducted as soon as conditions permit, and consequently make all changes, adjustments, or replacements required as the preliminary tests may indicate prior to the final tests. Tests shall be as specified in various sections of this Division. Carry out tests in the presence of the Consultant. Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project. The Electrical Contractor shall be in charge of the plant during tests. He shall assume responsibility for damages in the event of injury to the personnel, building, equipment, and shall bear all costs for liability, repairs, and restoration in this connection. Submit test results.
- .3 Make tests of equipment and wiring at times requested.
- .4 Tests shall include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load, and operation of each piece of equipment for correct operation.
- .5 Supply meters, materials and personnel as required to carry out these tests.
- .6 Test electrical work to standards and function of Specification and applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.
- .7 Connect single phase loads so that there is the least possible unbalance of the supply phases.
- .8 Submit all test results in report format.
- .9 Trial Usage
 - .1 The Consultant reserves the right to use any system, piece of equipment, device, or material for such reasonable lengths of time and at such times as may be required to make a complete and thorough test of the same, or for the purpose of learning operational procedures, before the final completion and acceptance of the work. Such tests shall not 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 above due to the aforementioned tests, where such injuries or breakage are caused by a weakness or inaccuracy of parts, or by defective materials or workmanship of any kind. Supply all labour and equipment required for such tests.
 - .2 Perform and pay for all costs associated with any testing required on the system components where, in the opinion of the Consultant the equipment manufacturer's ratings or specified performance is not being achieved.

1.26 Closeout Procedures

- .1 Refer to Section 01 77 00.
- .2 The Consultant will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.
- .3 Furnish a Certificate of Acceptance from Inspection Department on completion of work.

1.27 Closeout Submittals

- .1 Refer to Section 01 78 00.
- .2 Project Record Documents

- .1 Extra sets of white prints will be provided on which to make, as the job progresses, all approved changes and deviations from the original drawings. Complete Record Drawings accurately marked up in red ink must be submitted for approval before the contract is considered to be completed.
- .2 Changes and deviations include those made by addenda, change orders, and supplemental instructions, and changes and deviations to be marked on the white print record drawings indicated on supplemental drawings issued with addenda, change orders, and supplemental instructions. Maintain the "as-built" white prints at the site for periodic inspection by the Consultant throughout the duration of the work.
- .3 Upon substantial completion of the work, obtain a set of reproducible white prints of the drawings and neatly amend the print in accordance with the marked-up white prints to produce a true "as-built" set of drawings.
- .4 As-built drawings are to indicate all circuiting as installed and all distribution junction box locations as well as conduit routes.
- .5 Trace routing of existing panelboard feeders for all panelboards and indicate on as-built drawings.
- .6 As-Built AutoCAD Drawings
 - .1 Submit completed Document 00 64 01 to the Consultant, and remit payment as indicated for release of Consultant's AutoCAD files.
 - .2 Request CAD release form from Consultant, and submit back to Consultant.
 - .3 Transfer the information from the "as-built" white prints to the files, and submit to the Consultant for review.
 - .4 Employ a competent computer draftsman to indicate changes on the electronic set of record drawings. Provide drawings in PDF and AutoCAD formats.
 - .5 Submit three (3) USB flash drives including as-built drawings in AutoCAD format, one with each O&M manual.
 - .6 Provide three (3) sets of full size as-built drawings in hard copy format, one with each O&M manual.
- .7 As-built Single Line Diagram
 - .1 Provide in Main Electrical Room one wall mounted copy of as-built Single Line Diagram on 6 mm (1/4 in) foam board.
 - .2 As-built Single Line Diagram to indicate manufacturer name and catalogue numbers of as-installed products.
- .3 Operations and Maintenance (O&M) Data
 - .1 Submit two complete sets of Operation and Maintenance instruction manuals in hard copy, and one in electronic format. Include in each copy of the manual:
 - .1 Verification certificates for installation of life safety systems by the manufacturer's representative.
 - .2 A copy of "reviewed" shop drawings.
 - .3 Complete explanation of operating principles and sequences.
 - .4 Recommended maintenance practices and precautions.
 - .5 Complete wiring and connection diagrams.
 - .6 Certificates of guarantees.

- .2 Ensure that operating and maintenance instructions are specific and apply to the model and types of equipment provided.
- .3 Include attendance records for each training session in the O&M manual.
- .4 Warranties
 - .1 Submit a written guarantee to the Owner for two (2) years from the date of issue of Certificate of Substantial Performance of Work. This guarantee shall bind the contractor to correct, replace or repair promptly any defective equipment workmanship without cost to the Owner.
 - .2 All equipment, materials and workmanship shall be unconditionally guaranteed for a minimum period of one year from the date of acceptance.
 - .3 Provide warranty certificates, wherever given or required, in excess of the normal warranty period showing the name of the firm giving the warranty, dated and acknowledged, on specific equipment and systems.
 - .4 Warranties for temperature controls and building automation systems will start on the date of verification of acceptance by the Consultant.
 - .5 Include these certificates with the maintenance and operating manuals in the appropriate sections.

2 Products – Not Used

3 Execution

3.01 Demolition

- .1 Refer to Division 02 and Section 26 05 05.
- .2 Remove all electrical equipment and devices on redundant structures. Make safe all circuits, and provide continuity of remaining circuits.
- .3 To make safe: Withdraw redundant wiring and remove unwanted conduit/wiring and accessories. Position breakers to OFF position and update panel schedules.
- .4 Make safe any redundant mechanical devices as shown on mechanical drawings.
- .5 Maintain continuity of existing services for other circuits/devices serving areas outside the Work area. Provide additional wiring/conduits/boxes etc. to suit existing services to be maintained and also implement new Work as detailed.
- .6 Allow for this work in Tender Price.
- .7 Turn over designated equipment to the Owner. Dispose of unwanted materials and equipment.

3.02 Concrete Work

- .1 Refer to Division 03 – Concrete.
- .2 Provide all concrete work required for the electrical work. Reinstall surfacing as per architectural requirements.
- .3 Provide a 100 mm (4 inch) high concrete housekeeping pad for floor mounted electrical distribution equipment, such as the following:
 - .1 Transformers.
 - .2 Switchgear and switchboards.

- .3 Distribution panelboards.
- .4 Engine Generators.
- .5 Uninterruptible Power Supplies and batteries.
- .6 Transfer Switches.

3.03 Lintels

- .1 Refer to Division 04 – Masonry.
- .2 Lintels for openings in masonry shall conform with requirements of by-laws, and as approved by the Structural Engineer.
- .3 Pay all costs for lintels over openings, required solely by the electrical trades, not shown on architectural or structural drawings.

3.04 Metals

- .1 Refer to Division 05 – Metals.
- .2 Steel construction required solely for the work of this trade, and not shown on architectural or structural drawings shall be provided by this Division to the requirements of Division 05.

3.05 Flashing and Sheet Metal

- .1 Refer to Section 07 60 00.
- .2 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.
- .3 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.

3.06 Firestopping

- .1 Provide firestopping in accordance with Section 07 84 00.
- .2 Ensure that fire ratings of floors and walls are maintained.
- .3 Provide ULC classified firestopping products by 3M or Hilti which have been tested in accordance with CAN4-S115.
- .4 Pack clearance spaces, fill all spaces between openings, pipes and ducts passing through fire separations and install firestopping systems in accordance with the appropriate ULC system number for the products and type of penetration.
- .5 Install firestopping systems using personnel trained or instructed by the product manufacturer.

3.07 Access Doors

- .1 Provide access doors in accordance with Section 08 31 00.
- .2 Group conduit work to ensure the minimum number of access doors is required.
- .3 Access doors are to be installed by the trade responsible for the particular type of construction in which the doors are required.

3.08 Painting and Finishes

- .1 Refer to Section 09 91 00.
- .2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .3 Repair and finish factory finished equipment, damaged or scratched during installation, in an approved manner.

- .4 All structural steel including hangers, brackets, supports and other ferrous metals shall be shop or factory prime painted wherever practicable. Wherever structural steel including hangers, brackets, supports, and other ferrous metals cannot be shop or factory prime painted, wire brush to remove all traces of rust, clean of all traces of dirt, oil, and grease, and apply one coat of an approved rust inhibiting primer in accordance with CGSB-GB-40d, and leave ready to receive finish paint.
- .5 Primary and final painting for Work, other than items specified as factory primed or finished, will be performed as described in Division 09 – Finishes.
- .6 All electrical fittings, supports, hanger rods, pull boxes, channel frames, conduit racks, outlet boxes, brackets, clamps etc., to have galvanized finish or paint finish over corrosion-resistant primer.
- .7 All panelboards, motor starters etc., to be factory finished with baked on enamel. All enamel to be baked on gloss over corrosion resistant primer.
- .8 Touch up minor damage to finish on factory finished equipment. Items suffering major damage to finish shall be replaced at the direction of the Consultant.
- .9 Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.
- .10 Provide all exposed ferrous metal work on equipment with at least one factory prime coat, or paint one prime coat on job. Clean up or wire brush all equipment, etc., before painting.
- .11 For factory applied finishes, repaint or refinish surfaces damaged during shipment, erection or construction work.

3.09 Location of Outlets

- .1 Refer to Architectural drawings for dimensions denoting exact locations.
- .2 The Consultant reserves the right to change the location of outlets to within 3 m from the point indicated on the plans without extra charge providing the Contractor is advised before installation is made.
- .3 Location of lighting, convenience, telephone, power and communication outlets shall be subject to change, without extra cost to Owners, provided information is given prior to installation. No extra amount will be paid for extra labour and materials for relocating outlets up to 3000 mm from their original location nor will credits be anticipated where relocation up to 3000 mm reduces materials and labour. Other cases will be considered on their individual merits.
- .4 Coordinate location of boxes with latest architectural drawings and instructions to suit door swings, millwork etc. prior to rough-in.

3.10 Mounting Heights and Device Locations

- .1 Refer to architectural drawings for exact location of electrical equipment and devices.
- .2 Architectural elevations take precedence over electrical elevations. If there are conflicts between architectural and electrical, adjust locations of electrical equipment at no additional cost to the owner.
- .3 Prior to roughing-in, the contractor is to mark locations of electrical equipment and devices for conflicts with architectural, studs, etc. If conflicts are noted, inform the consultant for a decision prior to commencing the rough-in.
- .4 Mounting heights of equipment and devices listed below is from finished floor to centreline of equipment, unless specified or indicated otherwise.
- .5 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .6 Install electrical equipment at following heights above finished floor (AFF). Dimensions are to centre of device unless indicated otherwise.
 - .1 Power door operator push buttons: 1000 mm.

- .2 HVAC thermostats and manual HVAC controls: 1200 mm.
- .3 Local switches, and manual lighting control devices:
 - .1 1100 mm.
 - .2 Locate on lock side of door.
- .4 System furniture service fittings: to suit furniture layout.
- .5 Wall receptacles:
 - .1 General: min. 400 mm AFF.
 - .2 Above top of counters: 175 mm.
 - .3 Above top of continuous baseboard heater, or mechanical heating/radiation units: 75 mm to bottom of device.
 - .4 In fan rooms, mechanical rooms, and electrical rooms: 1100 mm.
- .6 Outlets in raceways or millwork to be located as per Architectural details.
- .7 Door bell pushbuttons: 1100 mm.
- .8 Panelboards: as indicated in Section 26 24 16.
- .9 Emergency lighting remote heads: 300 mm below finished ceiling, or 2400 mm AFF for exposed areas or areas with ceiling height above 2750 mm (9 feet).
- .10 Communications:
 - .1 Typical communication outlets (voice and data): 400 mm.
 - .2 Communications outlets for wall mounted telephones, intercom, or similar: 1100 mm.
 - .3 Television outlets: 200 mm below finished ceiling.
 - .4 Wall mounted public address speakers: 2100 mm.
 - .5 Clocks: 2100 mm.
- .11 Access control card readers and keypads: 900 mm.
- .12 Fire alarm manual pull stations: 1200 mm.
- .13 Wall mounted fire alarm audible devices, including bells or horns:
 - .1 2300 mm to the top of the device in areas of ceiling height 2450 mm or greater.
 - .2 150 mm below the finished ceiling for ceiling heights less than 2450 mm, measured to the top of the device.
- .14 Wall mounted fire alarm visible signal devices, including strobes: 2300 mm.
- .15 Fire Alarm emergency telephones: 1400 mm.

3.11 Manufacturer's Instructions

- .1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.
- .2 Follow manufacturer's instructions where they cover points now specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.12 Tests and Acceptance

- .1 The operation of the equipment and electrical system does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.
- .2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.
- .3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition, with raceway and conduit systems properly grounded, wiring free from grounds, shorts, and that the entire installation is free for any physical defects.

3.13 Closeout Activities

- .1 Refer to Section 01 79 00.
- .2 In the presence of the Owner, demonstrate the proper operation of all systems.
- .3 Instruct the Owner's designated representatives in all aspects of the operation and maintenance of systems and equipment listed in the trade sections governed by this Section. Obtain in writing from the Consultant a list of the Owner's representatives qualified to receive instructions.
- .4 Arrange for and pay for the services of qualified service technicians and other manufacturer's representatives required for instruction of specialized portions of the installation.

End of Section

1 General

1.01 Section Includes

- .1 Work in existing facilities.
- .2 Electrical demolition.

1.02 Related Requirements

- .1 Section 02 41 19.01 – Selective Structural Demolition.

1.03 Scheduling

- .1 Refer to Section 01 14 00, and Section 01 73 00.
- .2 All work in the existing building, other than minor works required to permit construction of the new Work, is to be performed in such a manner as to not disrupt the building operations.
- .3 All systems are to be kept in full operation during normal building hours.
- .4 Coordinate any noise generating works that disrupt the building operation to be carried out after/before normal operating hours.

2 Products

2.01 Materials

- .1 Materials and equipment for patching and extending work: As specified in individual sections.

3 Execution

3.01 Examination

- .1 Verification of Conditions
 - .1 Verify field measurements and circuiting arrangements are as shown on Drawings.
 - .2 Verify that abandoned wiring and equipment serve only abandoned facilities.
 - .3 Demolition drawings are based on casual field observation. Report discrepancies to the Consultant before disturbing existing installation.
 - .4 Beginning of demolition means installer accepts existing conditions.
- .2 Tracing Existing Electrical Circuits
 - .1 Trace all circuits in the area of work listed as existing, and verify existing conditions prior to any modifications as indicated.
 - .2 Where drawings indicate “connect to existing circuit”, use a spare breaker, where available. Otherwise, verify existing load with a meter and advise the Consultant if the additional load will cause a circuit to trip.
 - .3 Where provided panelboard schedules indicate "Existing Circuit" or similar, provide the correct description for the circuit. Existing Circuit will not be acceptable in the final panelboard schedules submitted as part of closeout submittals.
- .3 Existing Cabling in Return Air Plenums

- .1 In ceilings being used as a return air-plenum, Contractor to review existing low-voltage cabling uncovered as part of the work.
- .2 Immediately notify the Consultant if any cables identified are not plenum rated (i.e. CMP, or FT6 rated).

3.02 Preparation

- .1 Coordinate utility service outages with utility company.
- .2 Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- .3 Existing electrical service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switch overs and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- .4 Existing Telephone System: Maintain existing system in service. Notify Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- .5 Existing Fire Alarm System: Maintain existing system in service. Minimize outage duration. Provide fire watch as required. Make temporary connections to maintain service in areas adjacent to work area.

3.03 Demolition

- .1 Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- .2 Demolish and extend existing electrical work to Section 02 41 19, and this Section.
- .3 Remove, relocate, and extend existing installations to accommodate new construction.
- .4 Remove abandoned wiring to source of supply.
- .5 When relocating or removing equipment, should any circuits be abandoned, the conductors to these circuits must be removed or properly terminated as detailed in Ontario Electrical Safety Code (OESC) bulletin 12-25-1, or latest revision.
- .6 Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- .7 Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- .8 Disconnect and remove abandoned panelboards and distribution equipment.
- .9 Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- .10 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- .11 Repair adjacent construction and finishes damaged during demolition and extension work.
- .12 Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.
- .13 Maintain continuity of existing services for other circuits/devices serving areas outside the Work area. Provide additional wiring/conduits/boxes etc. to suit existing services to be maintained and also implement new Work as detailed.

3.04 Restoration

- .1 Install relocated materials and equipment under the provisions of Division 01.

3.05 Cleaning

- .1 Clean and repair existing materials and equipment which remain or are to be reused.
- .2 Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.
- .3 Waste Management
 - .1 Turn over designated equipment to the Owner.
 - .2 Dispose of unwanted materials and equipment.

3.06 Protection

- .1 Maintain access to existing electrical installations which remain active. Modify installation or provide access panels as appropriate.

End of Section

1 General

1.01 Section Includes

- .1 Building wire and cable.
 - .1 Armoured cable.
 - .2 Metal clad cable.
 - .3 Wiring connectors and connections.
- .2 Permitted voltage drop for feeder and branch circuits.
- .3 Conductor sizes are based on copper unless indicated as aluminum or "AL".

1.02 References

- .1 CSA Group:
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 0.3-09 (R2019), Test methods for electrical wires and cables.
 - .4 CSA C22.2 No. 48-15, Nonmetallic sheathed cable.
 - .5 CSA C22.2 No. 51-14, Armoured cables.
 - .6 CSA C22.2 No. 52-15, Underground secondary and service-entrance cables.
 - .7 CSA C22.2 No. 65-13, Wire connectors.
 - .8 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.
 - .9 CSA C22.2 No. 123-16, Aluminum sheathed cables.
 - .10 CSA C22.2 No. 131-14, Type TECK 90 cable.
- .2 NECA (National Electrical Contractors Association) - Standard of Installation.
- .3 NETA (International Electrical Testing Association) - ATS-2003 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- .4 CAN/ULC-S139:2017 – Standard Method of Fire Test for Evaluation of Integrity of Electrical Power, Data and Optical Fibre Cables.

1.03 Coordination

- .1 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

1.04 Closeout Submittals

- .1 Record Documents: Indicate as-constructed feeder sizes on single line diagram.

2 Products

2.01 Manufacturers

- .1 BICC Phillips.
- .2 General Cable.
- .3 Nexans.
- .4 Prysmian.
- .5 Southwire.

2.02 Regulatory Requirements

- .1 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2.03 Conductor Material

- .1 Submit bid based on copper conductors only, unless aluminum is explicitly indicated on the drawings.

[OR]

2.04 Building Wire

- .1 RW90:
 - .1 Single copper conductor.
 - .2 Minimum #12 AWG for branch circuit wiring.
 - .3 Minimum #14 AWG for 120 V control wiring.
 - .4 Chemically cross-linked polyethylene insulation.
 - .5 Rated for 90 degrees C, 600 V.
 - .6 Suitable for handling to minus 40 degrees C.
 - .7 For interior installations in conduit.
- .2 RWU90:
 - .1 Single copper conductor.
 - .2 Minimum 12 AWG for branch circuit wiring.
 - .3 Minimum 14 AWG for 120 V control wiring.
 - .4 Chemically cross-linked polyethylene insulation.
 - .5 Rated for 90 degrees C, 600 V.
 - .6 Suitable for handling to minus 4 degrees C.
 - .7 For exterior installations in conduit.
- .3 T90 Nylon:

- .1 Single copper conductor.
- .2 Thin wall PVC insulation with nylon covering.
- .3 Rated for 90 degrees C, 600 V.
- .4 May be used up to size 10 AWG for interior installations.
- .5 Base conduit fill on RW90 cable diameters.

2.05 Armoured Cable

- .1 Description: Type AC.
- .2 Two, three or four copper conductors rated RW90, 1000 V.
- .3 Bare copper ground wire.
- .4 Insulation Voltage Rating: 600 volts.
- .5 Insulation Temperature Rating: 90 degrees C (194 degrees F).
- .6 Insulation Material: Thermoplastic.
- .7 Runs to be limited to fixture drops and in walls, maximum exposed run 1.5 m.
- .8 Do not daisy chain (leap frog) luminaires with armoured cable.

2.06 Fire Rated Cables

- .1 General:
 - .1 2 hour fire rating to ULC S139 and to meet 2020 Ontario Building Code Rule 3.2.7.10.
 - .2 Alternative means of compliance:
 - .1 Conduits encased in a minimum of 50 mm (2 in) of concrete.
 - .2 Be protected by a fire rated assembly listed to achieve the minimum fire rating as indicated.
- .2 Manufacturers:
 - .1 nVent Pyrotenax 1850 series (basis of design).
 - .2 VITALink MC Brand Type MC, manufactured by Marmon Wire & Cable Inc. (listed by ULC under ULC category code 'FHIT7' or 'FHJR7', dated 19 May 2015).
 - .1 Request quotation from Bhavik Jain at Cerco Cable (905.670.3777) for field certification of installed Vitalink cables prior to requesting Engineer's construction field review.
 - .2 2-Hour rated Vitalink RC90 power cable must be installed according to UL protocol FHIT7.120 – Electrical circuit integrity systems certified in Canada.
- .3 Substitution Limitations:
 - .1 "Lifeline" installed in conduit may only be considered if listed by ULC under ULC Category Codes 'FHIT7' or 'FHJR7'.

2.07 Wiring Termination

- .1 Lugs, terminals, or screws used for termination of wiring to be suitable for copper conductors. Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring. Maintain phase sequence and colour coding throughout.
- .2 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.
 - .1 Thomas & Betts – Marr Max Series
- .3 Splice large conductors using compression type connections insulated with heat shrink sleeves.
 - .1 Thomas & Betts – 5400 Series lugs & heat shrink type #s series

2.08 Conductors, Wires, and Cables

- .1 Indoor wiring installed in conduit, unless otherwise noted: 600 volt "RW90 XLPE".
- .2 Wiring in channel back of fluorescent lighting fixtures: 600 volt type GTF or TEW.
- .3 Lighting and power branch circuit wiring:
 - .1 Copper, minimum No. 12 gauge.
 - .2 Home runs to lighting and receptacle panels, which exceed 22 m (75 feet) in length: minimum No. 10 gauge.
- .4 Size wires for 2 per cent maximum voltage drop to farthest outlet on a maximum 80 per cent loaded circuit.
- .5 Outdoor wiring: "RWU90 XLPE".
- .6 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.
- .7 Colour coding as follows:
 - .1 Phase "A" - Red
 - .2 Phase "B" - Black
 - .3 Phase "C" - Blue
 - .4 Control - Orange
 - .5 Ground - Green
 - .6 Neutral - White
- .8 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

3 Execution

3.01 Examination

- .1 Verify that field measurements are as indicated.
- .2 Wire and cable routing indicated is approximate unless dimensioned.
- .3 Voltage Drop

- .1 Ensure voltage drop in power and control conductors is in accordance with the requirements of the OESC.
- .2 Size conductors accordingly when sizes are not identified.
 - .1 Feeder conductors: maximum voltage drop of 2 per cent.
 - .2 Branch circuit conductors: maximum voltage drop of 3 per cent.
- .4 Verify that mechanical work likely to damage wire and cable has been completed.
- .5 Verify that raceway installation is complete and supported.

3.02 Preparation

- .1 Completely and thoroughly swab raceway before installing wire.

3.03 Installation

- .1 Route wire and cable as required to meet project conditions.
- .2 Install cable to CSA C22.1.
- .3 Conduit and cable supports:
 - .1 All wiring to be installed in EMT at all exposed areas and in partitions unless otherwise specified.
 - .2 All mechanical equipment to be connected with liquid tight flexible conduit.
 - .3 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
- .4 Conductors
 - .1 Provide separate neutral for each circuit. Common neutrals not permitted.
 - .2 Use solid conductor for feeders and branch circuits 10 AWG and smaller.
 - .3 Use stranded conductors for control circuits.
 - .4 Use conductor not smaller than 12 AWG for power and lighting circuits.
 - .5 Use conductor not smaller than 16 AWG for control circuits.
 - .6 Armoured cable (commonly referred to as BX) is only to be used for light fixture connections and limited to maximum 1830 mm in length.
 - .7 Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 25 m.
- .5 Pulling conductors
 - .1 Pull all conductors into raceway at same time.
 - .2 Use suitable wire pulling lubricant for building wire 4 AWG and larger.
 - .3 Neatly train and lace wiring inside boxes, equipment, and panelboards.
 - .4 Protect exposed cable from damage.
- .6 Connectors

- .1 Use suitable cable fittings and connectors.
- .2 Clean conductor surfaces before installing lugs and connectors.
- .3 Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- .4 Use split bolt connectors for copper conductor splices and taps 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 per cent of insulation rating of conductor.
- .5 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- .6 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- .7 Identification
 - .1 Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
 - .2 Where colour-coded tape is utilized, apply a minimum of 50 mm (2 inches) at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition.
 - .3 Utilize colour coding on bussing in panels and, switchgear, disconnects, and metering cabinets to match conductor colour coding.

End of Section

1 General

1.01 Section Includes

- .1 Low-voltage control cabling.
- .2 Control-circuit conductors.

1.02 References

- .1 CSA Group:
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 0.3-09 (R2019), Test methods for electrical wires and cables.
 - .4 CSA C22.2 No. 48-15, Nonmetallic sheathed cable.
 - .5 CSA C22.2 No. 51-14, Armoured cables.
 - .6 CSA C22.2 No. 65-13, Wire connectors.
 - .7 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.
 - .8 CSA C22.2 No. 208-14, Fire alarm and signal cable.
- .2 NECA (National Electrical Contractors Association) - Standard of Installation.

1.03 Coordination

- .1 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

2 Products

2.01 Regulatory Requirements

- .1 Conform to CSA C22.1.
- .2 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2.02 Low Voltage Wiring

- .1 LVT:
 - .1 Multi conductor PVC insulated.
 - .2 Bare copper ground conductor.
 - .3 Overall PVC jacket.
 - .4 Rated 30 V.
 - .5 CMP (FT6) rated if cable is exposed.
 - .6 CMR (FT4) rated if cable is installed in conduit.
- .2 Category 5e Network Cabling.

- .1 CMP (FT6) rated if cable is exposed.
- .2 CMR (FT4) rated if cable is installed in conduit.

2.03 Terminations and Splices

- .1 All terminations and splices shall be of an approved type for the conductors being used.
- .2 Where conductors are terminated or spliced, it shall be done in the following manner:
 - .1 Where a single solid conductor is terminated in a device under one screw or clamping mechanism, no additional terminating hardware is required.
 - .2 Where multiple or stranded conductors are terminated in a device under one screw or clamping mechanism, self insulated crimp-on cable ends or approved equal shall be used up to and including No. 10 sized conductors. Approved compression lugs shall be used for larger conductor sizes.
 - .3 Where multiple conductors are spliced, properly sized Wing Nut connectors, or approved equal, shall be used for up to two No. 8 or three No. 10 AWG conductors. Pressure type sleeve cable connectors, splices, tee's, etc., shall be used for all larger size connections and terminations.
 - .4 Insulate all bare surfaces of splices with heat shrink sleeving or equivalent.
 - .5 Conductors connected to ground rods for service or equipment grounding or to building structural or architectural elements shall be terminated, connected and spliced using a thermoweld process or approved non-mechanical compression type connectors.
- .3 Install all service and feeder conductors as continuous lengths without breaks, measured and cut based on site dimensions.

3 Execution

3.01 Examination

- .1 Verify that mechanical work likely to damage wire and cable has been completed.
- .2 Verify that raceway installation is complete and supported.
- .3 Verify that field measurements are as indicated.
- .4 Wire and cable routing indicated is approximate unless dimensioned.

3.02 Preparation

- .1 Completely and thoroughly swab raceway before installing wire.

3.03 Installation

- .1 Route control cabling as required to meet project conditions.
- .2 Install cable to the CSA C22.1.
- .3 Conduit and supports
 - .1 All wiring to be installed in EMT at all exposed areas and in partitions unless otherwise specified.
 - .2 All mechanical equipment to be connected with liquid tight flexible conduit.

- .3 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
- .4 Conductors
 - .1 Use stranded conductors for control circuits.
 - .2 Use conductor not smaller than 16 AWG for control circuits.
- .5 Pulling conductors
 - .1 Pull all conductors into raceway at same time.
 - .2 Neatly train and lace wiring inside boxes, equipment, and panelboards.
 - .3 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.
 - .4 Protect exposed cable from damage.
- .6 Connectors
 - .1 Use suitable cable fittings and connectors.
 - .2 Clean conductor surfaces before installing lugs and connectors.
 - .3 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - .4 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- .7 Identification
 - .1 Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
 - .2 Where colour coded tape is utilized, apply a minimum of 50 mm (2 inches) at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition.

End of Section

1 General

1.01 Section Includes

- .1 Grounding electrodes and conductors.
- .2 Equipment grounding conductors.
- .3 Bonding.
- .4 The terms “connect” and “bond” are used interchangeably in this Specification and have the same meaning.

1.02 Related Requirements

- .1 Section 09 65 36.13 – Static-Dissipative Resilient Flooring: Grounding of static dissipative tile (SDT).
- .2 Section 09 69 00 – Access Flooring: Grounding of raised floor pedestals.
- .3 Section 27 05 26 – Grounding and Bonding for Communications Systems.

1.03 References

- .1 CSA Group
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No.0.4-17, Bonding of electrical equipment.
 - .4 CSA C22.2 No. 41-13, Grounding and bonding equipment.
 - .5 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.
- .2 ANSI/TIA/EIA J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .3 Institute of Electrical and Electronics Engineers, Inc.
 - .1 IEEE 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

1.04 Action Submittals

- .1 Product Data: Provide for grounding electrodes and connections.

1.05 Informational Submittals

- .1 Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- .2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 Closeout Submittals

- .1 Project Record Documents: Record actual locations of components and grounding electrodes.
- .2 Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.07 Regulatory Requirements

- .1 Products: Listed and classified testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2 Products

2.01 Manufacturers

- .1 B-Line by Eaton.
- .2 Hubbell (Burdny).
- .3 Panduit.
- .4 Thomas & Betts.

2.02 Performance Criteria

- .1 Grounding System Resistance: 5 ohms.
- .2 Provide all equipment grounding as required regardless of whether it has been shown on drawings or called for in this specification. Arrange grounds so that under normal operating conditions no injurious amount of current will flow in any grounding conductor.

2.03 Grounding and Bonding Conductors

- .1 Electrical grounding conductors shall be CSA C22.2 No. 75 insulated stranded copper, except that sizes #10 AWG and smaller shall be solid copper. Insulation colour shall be continuous green for all equipment grounding conductors.
- .2 Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes #10 AWG and smaller shall be ASTM B1 solid bare copper wire.

2.04 Rod Electrodes

- .1 Material: Copper-clad steel.
- .2 Diameter: 19 mm.
- .3 Length: 3000 mm.

2.05 Ground Rods

- .1 Copper clad steel, 19 mm (3/4 inch) diameter by 3000 mm (10 feet) long, conforming to CSA C22.2 No. 41.
- .2 Quantity of rods shall be as required to obtain the specified ground resistance.

2.06 Splices and Termination Components

- .1 Components shall meet or exceed CSA C22.2 No. 41, and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.07 Ground Connections

- .1 Below Grade: Exothermic-welded type connectors.
- .2 Above Grade:

- .1 Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
- .2 Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

2.08 Ground Terminal Blocks

- .1 At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.09 Splice Case Ground Accessories

- .1 Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 6 AWG insulated ground wire with shield bonding connectors.

2.10 Mechanical Connectors

- .1 Material: Bronze.

2.11 Wire

- .1 Material: Stranded copper.
- .2 Foundation Electrodes: 2/0 AWG.
- .3 Grounding Electrode Conductor: Size to meet Ontario Electrical Safety Code requirements.

2.12 Grounding Well Components

- .1 Well Pipe: 200 mm by 600 mm long concrete pipe with belled end.
- .2 Well Cover: Cast iron with legend "GROUND" embossed on cover.

3 Execution

3.01 Examination

- .1 Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 Installation

- .1 General
 - .1 Ground in accordance with the Ontario Electrical Safety Code, as shown on drawings, and as hereinafter specified.
 - .2 System Grounding:
 - .1 Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
 - .2 Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
 - .3 Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.
 - .4 Ground electrical equipment and wiring in accordance with Ontario Electrical Safety Code and Local Inspection Authority's Rules and Regulations.

- .5 Install grounding conductors, outside Electric Rooms and Electrical Closets in conduit and conceal where possible. Make connections to water mains, all metallic piping systems, neutral and equipment with brass, copper or bronze bolts and connectors or weld using Cadweld or Thermoweld processes.
- .6 Provide grounding conductors, sized as per Code, and connect to grounding bus or water main wherever non-raceways are installed.
- .2 Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.
- .3 Provide bonding to meet Regulatory Requirements.
- .4 Bond together metal siding not attached to grounded structure; bond to ground.
- .5 Install ground grid under access floors indicated.
- .6 Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use #6 AWG bare copper conductor.
- .7 Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- .8 Ground Resistance
 - .1 Grounding system resistance to ground not to exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Owner. Final tests shall assure that this requirement is met.
 - .2 Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
 - .3 Services at power company interface points shall comply with the power company ground resistance requirements.
- .9 Ground Rod Installation
 - .1 Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.
 - .2 Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
 - .3 Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.
- .10 Inaccessible Grounding Connections
 - .1 Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.
- .11 Secondary Equipment and Circuits
 - .1 Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
 - .2 Metallic Piping, Building Steel, and Supplemental Electrode(s):
 - .1 Provide a grounding electrode conductor sized per code between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating

- joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to CSA C22.2 No 41.
- .2 Provide a supplemental ground electrode and bond to the grounding electrode system.
 - .3 Conduit Systems:
 - .1 Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - .2 Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
 - .3 Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
 - .4 Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
 - .5 Boxes, Cabinets, Enclosures, and Panelboards:
 - .1 Bond the equipment grounding conductor to each pull box, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 - .2 Provide lugs in each box and enclosure for equipment grounding conductor termination.
 - .3 Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
 - .6 Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
 - .7 Raised Floors: Provide bonding of all raised floor components.
 - .12 Corrosion Inhibitors
 - .1 When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.
 - .13 Conductive Piping
 - .1 Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.03 Field Quality Control

- .1 Perform inspections and tests listed in NETA ATS, Section 7.13.

End of Section

1 General

1.01 Section Includes

- .1 Conduit and equipment supports.
- .2 Anchors and fasteners.

1.02 References

- .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (27th edition/2018).
- .3 CECA - Canadian Electrical Contractors Association.

1.03 Closeout Submittals

- .1 Submit the following in the Operation and Maintenance Manual for products used over the course of the project:
 - .1 Product Data: Provide manufacturer's catalogue data for fastening systems.
 - .2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.04 Regulatory Requirements

- .1 Provide products listed and classified by Canadian Standards as suitable for purpose specified and shown.

2 Products

2.01 Manufacturers

- .1 B-line by Eaton.
- .2 Burndy Canada Ltd. (Hubbell).
- .3 Erico Caddy.
- .4 E. Myatt & Co. Inc.
- .5 Hilti Canada.
- .6 Thomas & Betts.
- .7 Unistrut.
- .8 Approved equal.

2.02 General

- .1 All supporting devices, strut channel, threaded rod, anchors, etc. to be used shall be of the "hot dipped" galvanized type. Electro galvanized components will not be accepted.
- .2 Materials and Finishes: Provide adequate corrosion resistance.
- .3 Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

- .4 Anchors and Fasteners:
 - .1 Concrete Structural Elements: Use expansion anchor and preset inserts.
 - .2 Steel Structural Elements: Use beam clamps and welded fasteners.
 - .3 Concrete Surfaces: Use self-drilling anchors and expansion anchors.
 - .4 Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
 - .5 Solid Masonry Walls: Use expansion anchors and preset inserts.
 - .6 Sheet Metal: Use sheet metal screws.
 - .7 Wood Elements: Use wood screws.

2.03 Anchors and Hangers

- .1 Hangers for electrical conduit shall be galvanized after fabrication.
- .2 Perforated strapping: not permitted.

2.04 Inserts

- .1 Use only factory-made threaded or toggle type.
- .2 Where inserts cannot be placed, use factory-made expansion shields for light weights, where approved by the Consultant.
- .3 Do not use powder-activated tools except with the written permission of the Consultant.

2.05 Sleeves

- .1 Through interior walls, use standard weight steel pipes, conduit, or 18 gauge galvanized steel. Cut flush with finished surfaces. Check room finish schedules.
- .2 Through exterior walls above grade, floors, and roof use standard weight steel pipes, machine cut, flush with finished surface inside and to suit flashing outside.
- .3 Through exterior walls below grade, water-proofed floors, and other water-proof walls, use heavy weight cast iron pipes, machine cut. Extend sleeves 100 mm (4 inches) above finished floors, and cut flush with underside of floor.

2.06 Steel Channel

- .1 Description: Painted steel.

2.07 Supports

- .1 Steel supports in wet or dry locations to be galvanized after fabrication.
- .2 Where galvanized members are bolted together use cadmium plated bolts.
- .3 For hanger rods use minimum 10 mm (3/8 inch) diameter steel threaded rod. Use clevis type attachment.
- .4 Provide minimum 100 mm (4 inch) high concrete bases for all floor mounted equipment.

2.08 Supports and Bases

- .1 Submit proposed method of attachment of hangers and beam clamps, to cellular steel deck for approval before proceeding with Work.

- .2 Supply and erect special structural Work required for the installation of electrical equipment. Provide anchor bolts and other fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.
- .3 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets.
- .4 Provide channel or other metal supports where necessary, to adequately support lighting fixtures. Do not use wood unless wood forms part of the building structure.
- .5 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members, required between beams for supporting conduits and cables.
- .6 Provide any additional supports required from existing concrete construction for any piping or equipment, by drilling same and installing expansion bolt cinch anchors.
- .7 Do not use explosive drive pins in any section of Work without obtaining prior approval.

2.09 Threaded Rod Covers

- .1 Protect cable from abrasion caused by contact with threaded rod.
- .2 To meet UL 94V-0 specifications.
- .3 Colour: Black.
- .4 Example product: Panduit TRC18FR-X20Y.

3 Execution

3.01 Installation

- .1 Obtain permission from Consultant before drilling or cutting structural members.
- .2 Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- .3 Install surface-mounted cabinets and panelboards with minimum of four anchors.
- .4 In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm (1 inch) off wall.
- .5 Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- .6 Where threaded rod is exposed in data centre, provide threaded rod cover.
- .7 Provide inserts, sleeves, equipment supports and hangers, sealing of sleeves and openings, as required for all electrical work. Ensure that the load onto structures does not exceed the maximum loading per square metre as shown on Structural Drawings or as directed by the Consultant.
- .8 Provide insets, holes, anchor bolts and sleeves in time when walls, floors, and roof are erected.
- .9 Provide sleeves at each place where electrical devices pass through a wall, floor or roof.
- .10 Size sleeves to provide 13 mm (1/2 inches) clearance all round.
- .11 Sleeves are not required in interior walls and dry area floors where conduit is installed ahead of floor construction.
- .12 Seal all openings and sleeves after installation of equipment:

- .1 With an approved material to maintain fire rating where sleeves and openings pass through fire separations and floors.
- .2 With an approved material to maintain fire rating for sleeves and openings provided for future equipment.
- .13 Provide all flashing and waterproofing for sleeves through roof and exterior walls to the requirements of Division 07.
- .14 Place insets only in structural members and not in the finishing material.
- .15 Secure all supports and hangers to the structure unless noted otherwise.
- .16 Suspend hanger rods from approved concrete inserts and from beam clamps. Obtain Consultant's approval before welding to steel structural members.
- .17 Secure supports to precast concrete members to inserts originally cast into the members or by rods passing between the members and connected to a steel plate bearing.
- .18 Sealing of Sleeves and Openings to Maintain Fire Rating
 - .1 Use Dow-Corning #3-6548 'Silicone RTV' foam, Thomas & Betts "Flamesafe" firestop system, Electrovert 'Flameseal' firestop putty, or approved equal materials installed in accordance with the manufacturer's specifications and recommendations.
 - .2 Submit data sheets for review prior to installation.
- .19 Supports
 - .1 All conduits, panels, etc. to be securely and adequately supported.
 - .2 Where more than three conduits run together, conduit racks to be used.
 - .3 Single runs of conduit to be supported by galvanized conduit straps or ring bolt type hangers. Tie wire or perforated metal strap hangers will NOT be accepted.

End of Section

1 General

1.01 Section Includes

- .1 Metal conduit.
- .2 Flexible metal conduit.
- .3 Liquid tight flexible metal conduit.
- .4 Electrical metallic tubing.
- .5 Fittings and conduit bodies.

1.02 References

- .1 Canadian Standards Association
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CAN/CSA-C22.2 No. 18 – Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .4 CSA C22.2 No. 45 – Rigid Metal Conduit.
 - .5 CSA C22.2 No. 45.1 – Rigid Metal Conduit - Steel.
 - .6 CSA C22.2 No. 56 – Flexible Metal Conduit and Liquid - Tight Flexible Metal Conduit.
 - .7 CSA C22.2 No. 83.1 – Electrical Metallic Tubing - Steel.
 - .8 CSA C22.2 No. 211.1 – Rigid Types EB1 and DB2/ES2 PVC Conduit.
 - .9 CSA C22.2 No.211.2 – Rigid PVC (Unplasticized) Conduit.
 - .10 CSA C22.2 No. 211.3 – Reinforced Thermosetting Resin Conduit (RTRC) on Fittings.
 - .11 CSA C22.2 No. 227.1 – Electrical Nonmetallic Tubing.
 - .12 CSA C22.2 No. 227.2.1 – Liquid-Tight Flexible Nonmetallic Conduit.

1.03 Project Record Documents

- .1 Accurately record actual routing of conduits larger than 51 mm.
- .2 Accurately record actual routing of all conduits installed below grade, regardless of size, including whether direct buried or installed in concrete duct bank.

1.04 Regulatory Requirements

- .1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for purpose specified and shown.

1.05 Delivery, Storage, and Handling

- .1 Accept conduit on site. Inspect for damage.
- .2 Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.06 Project Conditions

- .1 Verify that field measurements are as shown on drawings.
- .2 Verify routing and termination locations of conduit prior to rough-in.
- .3 Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

2 Products

2.01 Manufacturers

- .1 Where products are listed in this section based on a single manufacturer, the equivalent product from the following manufacturers is acceptable:
 - .1 Appleton.
 - .2 Columbia-MBF.
 - .3 Crouse-Hinds by Eaton.
 - .4 Hubbell.
 - .5 Thomas & Betts Ltd.

2.02 Conduit Requirements

- .1 Minimum size: 21 mm (3/4 inch) unless otherwise specified.
- .2 Outdoor locations, above grade: use rigid steel.
- .3 Wet and damp locations: use rigid and non-metallic tubing.
- .4 Dry locations:
 - .1 Concealed: Use electrical metallic tubing
 - .2 Exposed: Use electrical metallic tubing.

2.03 Metal Conduit

- .1 Rigid Steel Conduit: C22.2 No. 45.1.
- .2 Rigid Aluminum Conduit: C22.2 No. 45.
- .3 Intermediate Metal Conduit (IMC): Rigid steel.
- .4 Fittings and Conduit Bodies: Material to match conduit.

2.04 Flexible Metal Conduit

- .1 Description: Interlocked steel construction.
- .2 Fittings: CSA C22.2 No. 56.

2.05 Liquid Tight Flexible Metal Conduit

- .1 Description: Interlocked steel aluminum construction with PVC jacket.

- .2 Fittings: CSA C22.2 No. 56.

2.06 Electrical Metallic Tubing (EMT)

- .1 Description: CSA C22.2 No. 83.1; galvanized tubing.
- .2 Fittings and Conduit Bodies: CSA C22.2 No. 83.1; steel type.

2.07 Electrical Nonmetallic Tubing (ENT)

- .1 Not permitted.

2.08 Conduit, Fittings, and Accessories

- .1 Conduit accessories, conduits and fittings conforming to CSA Standard C22.2 No. 18-1972.
- .2 Rigid conduit bushings:
 - .1 Thomas & Betts Ltd. - Series 5031.
- .3 EMT Connectors:
 - .1 Thomas & Betts Ltd. - Steel City TC 121E Series.
- .4 Ground Bushings:
 - .1 Thomas & Betts – Blackjack or 1220 Series.
- .5 Flexible conduit connectors:
 - .1 Thomas & Betts Ltd. - Series 3110.
 - .2 EMT couplings: steel concrete tight to match connectors.
- .6 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.
 - .1 Thomas & Betts – 8125 Series.
- .7 Terminate EMT entering boxes or enclosures with nylon insulated steel concrete tight connectors.
- .8 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.
 - .1 Thomas & Betts – 5332 Series.

3 Execution

3.01 Installation

- .1 Install conduit to CSA C22.1.
- .2 Arrangement and supports
 - .1 Arrange supports to prevent misalignment during wiring installation.
 - .2 Arrange conduit to maintain headroom and present neat appearance.
 - .3 Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

- .4 Group related conduits; support using conduit rack.
- .5 Construct rack using steel channel; provide space on each for 25 per cent additional conduits.
- .6 Fasten conduit supports to building structure and surfaces to Section 26 05 29.
- .7 Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports
- .8 Do not attach conduit to ceiling support wires.
- .9 Route exposed conduit parallel and perpendicular to walls.
- .10 Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- .11 Route conduit in and under slab from point-to-point.
- .12 Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- .13 Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
- .3 Clearances
 - .1 Maintain adequate clearance between conduit and piping.
 - .2 Maintain 300 mm (12 inch) clearance between conduit and surfaces with temperatures exceeding 40 degrees C.
- .4 Conduit bends
 - .1 Install no more than equivalent of three 90 degree bends between boxes.
 - .1 Use conduit bodies to make sharp changes in direction, as around beams.
 - .2 Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 50 mm size.
- .5 Install wall entrance seals where conduits pass through exterior walls below grade.
- .6 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.
- .7 Cut conduit square using saw or pipe cutter; de-burr cut ends.
- .8 Bring conduit to shoulder of fittings; fasten securely.
- .9 Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- .10 Use conduit hubs or sealing locknuts to fasten conduit and to cast boxes.
- .11 Provide suitable pull string in each empty conduit except sleeves and nipples.
- .12 Ground and bond conduit to Section 26 05 26.
- .13 Identify conduit to Section 26 05 53.
- .14 Wiring Methods
 - .1 Install wiring in conduit unless otherwise specified.
 - .2 Install wiring and conduit work in a concealed manner. Surface conduit work is not permitted unless specifically noted.

- .3 Use thin wall conduit, up to and including 53 mm (2 inch) conduit size, for branch circuit and feeder wiring in ceilings, furred spaces, and in hollow walls and partitions. Use rigid galvanized steel conduit for wiring in poured concrete, where exposed, and for conduit 65 mm or larger. Use rigid PVC conduit for wiring in slabs on grade and wiring below grade.
- .4 Aluminium conduit may be used, in lieu of rigid steel conduit, in clean and dry locations, but shall not be used in poured concrete, or for signal and intercommunication systems wiring.
- .5 Flexible conduit and armoured cable will be accepted for a maximum length of 1500 mm for final connection to lighting fixtures. Do not connect from fixture to fixture.
- .6 Conduit manufacturer's touch-up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

End of Section

1 General

1.01 Section Includes

- .1 Wall and ceiling outlet boxes.
- .2 Pull and junction boxes.

1.02 Related Requirements

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 27 16 – Electrical Cabinets and Enclosures.
- .3 Section 26 27 26 – Wiring Devices: Wall plates in finished areas, floor box service fittings, fire-rated poke-through fittings, and access floor boxes.
- .4 Section 26 27 26.13 – Floor Box Assemblies.

1.03 References

- .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (27th edition/2018).
- .3 CAN/CSA-C22.2 No. 18 - Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .4 CSA C22.2 No. 18.1 (CSA/UL/ANCE) - Metallic Outlet Boxes.
- .5 CSA C22.2 No. 40 - Cutout, Junction and Pull Boxes.
- .6 CAN/CSA-C22.2 No. 85 - Rigid PVC Boxes and Fittings.

1.04 Closeout Submittals

- .1 Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.05 Regulatory Requirements

- .1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

2 Products

2.01 Outlet Boxes

- .1 Sheet Metal Outlet Boxes: CSA C22.2 No. 18, galvanized steel.
 - .1 Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 13 mm male fixture studs where required.
 - .2 Concrete Ceiling Boxes: Concrete type.
- .2 Non-metallic Outlet Boxes: CSA C22.2 No. 18.
- .3 Cast Boxes: CSA C22.2 No. 18, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- .4 Wall Plates for Finished Areas: As specified in Section 26 27 26.

2.02 Pull Boxes and Junction Boxes

- .1 Sheet Metal Boxes: CSA C22.2 No. 18, galvanized steel.
- .2 Hinged Enclosures: As specified in Section 26 27 16.
- .3 Surface Mounted Cast Metal Box: CSA C22.2 No. 18, Type 4; flat-flanged, surface mounted junction box:
 - .1 Material: Cast aluminum.
 - .2 Cover: Provide with ground flange, neoprene gasket, and stainless steel cover screws.

2.03 Outlet Boxes

- .1 Conform to CSA C22.2 No. 18.
- .2 Where 103 mm (4 inch) square outlet boxes are installed in exposed concrete or cinder block finished areas, blocks will be cut as described in Division 04 as instructed under this Section. Cut openings to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Use of mortar to patch up openings that are cut too large or to patch ragged edges is not permitted.
- .3 Ceiling boxes: 103 mm (4 inch) octagon or square, complete with fittings, where required to support fixtures.
- .4 Switch and receptacle boxes:
 - .1 103 mm (4 inch) square with plaster ring, where flush mounted in plaster walls.
 - .2 Iberville 1104 series box, or equal, where flush mounted in wood or drywall, with stud fasteners as required.
 - .3 Masonry boxes in masonry walls.
- .5 Where boxes are surface mounted in unfinished areas they shall be FS conduits.
- .6 Standard outlet boxes manufactured from code gauge galvanized steel.
- .7 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.
- .8 Support outlet boxes independently of conduit and cable.
- .9 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.
- .10 Offset outlet boxes, shown back to back in partitions, horizontally a minimum 150 mm (6 inch) to minimize noise transmission between adjacent rooms.
- .11 Use gang boxes at locations where more than one device, of the same system only, is to be mounted. Utilize separate boxes for each system.
- .12 Use tile wall covers where 103 mm (4 inch) square outlet boxes are installed in exposed concrete or cinder block in finished areas.
- .13 Provide flush mount boxes, panels, cabinets and electrical devices, which are installed in finished areas, with suitable flush trims and doors or covers, unless specifically noted otherwise.
- .14 Provide pre-formed polyethylene vapour barriers for all boxes located in walls with internal vapour barriers.

3 Execution

3.01 Examination

- .1 Verify locations of floor boxes prior to rough-in.

3.02 Installation

- .1 Install boxes to CSA C22.1.
- .2 Install in locations as shown on drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- .3 Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- .4 Electrical boxes are shown on drawings in approximate locations unless dimensioned. Adjust box location up to 3 m (10 feet) if required to accommodate intended purpose.
- .5 Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- .6 Maintain headroom and present neat mechanical appearance.
- .7 Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- .8 Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 150 mm (6 inch) from ceiling access panel or from removable recessed luminaire.
- .9 Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods.
- .10 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- .11 Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- .12 Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- .13 Use flush mounting outlet box in finished areas.
- .14 Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- .15 Do not install flush mounting box back-to-back in walls; provide minimum 150 mm separation. Provide minimum 600 mm separation in acoustic rated walls.
- .16 Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- .17 Use stamped steel bridges to fasten flush mounting outlet box between studs.
- .18 Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- .19 Use adjustable steel channel fasteners for hung ceiling outlet box.
- .20 Do not fasten boxes to ceiling support wires.
- .21 Support boxes independently of conduit.
- .22 Use gang box where more than one device is mounted together. Do not use sectional box.
- .23 Use gang box with plaster ring for single device outlets.

- .24 Use cast outlet box in exterior locations exposed to the weather.
- .25 Use cast outlet box in wet locations.
- .26 Set floor boxes level.
- .27 Large pull boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.03 Adjusting

- .1 Adjust floor box flush with finish flooring material.
- .2 Adjust flush-mounting outlets to make front flush with finished wall material.
- .3 Install knockout closures in unused box openings.

3.04 Cleaning

- .1 Clean interior of boxes to remove dust, debris, and other material.
- .2 Clean exposed surfaces and restore finish.

End of Section

1 General

1.01 Section Includes

- .1 Metal Raceway is an enclosed pathway used for surface distribution of branch circuit electrical wiring, and cabling for voice, data, multi-media, low voltage, and optical fiber. Raceway is typically installed in existing building structures, or after construction is complete. A complete raceway system includes raceway, covers, mounting hardware, various fittings, and outlet boxes installed at specific locations. Specific codes and standards apply to electrical wires and telecommunications cables that are deployed within metal raceway. Compliance to codes and standards is required for installation, grounding and bonding, and cable deployment.

1.02 Related Requirements

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.03 Quality Assurance

- .1 Product free from defects in material or workmanship.
- .2 Materials and work specified in this document shall comply with, and are not limited to the codes, standards, and regulations listed below.
 - .1 CSA C22.1 - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.
 - .2 National Electrical Manufacturer's Association (NEMA)
 - .1 ANSI/NEMA WD-6-2002: Wiring Devices – Dimensional Requirements
 - .2 NEMA 250-2003: Enclosures for Electrical Equipment.
 - .3 Performance Requirements:
 - .1 Metal raceway and fittings UL Listed and CSA certified.

1.04 Submittals

- .1 Product Data Sheet.
- .2 Manufacturer's Instructions.
- .3 Product Catalog Literature.
- .4 Product Drawings.

1.05 Warranty

- .1 Product is warranted free of defects in material or workmanship.
- .2 Product is warranted to perform the intended function within design limits.

2 Products

2.01 Manufacturers

- .1 Wiremold Legrand.

- .2 Hubbell.
- .3 Thomas & Betts Canada.

2.02 Surface Mounted Raceway, General

- .1 The raceway and all system components must be UL Listed and exhibit non-flammable self-extinguishing characteristics tested to comparable specifications of UL94V-0. The raceway base and cover shall be manufactured by rigid compound, available in ivory or white colours, and allow for field painting.

2.03 Metal Raceway

- .1 Metal raceway shall be a one-piece design with base and cover, factory assembled, with mounting hardware and instructions included.
- .2 Metal raceway, cover, surface boxes, shall be a formed steel construction with a thickness of 0.040", and zinc plated. Related fittings shall be galvanized on all surfaces.
- .3 Metal raceway, cover, and related fittings shall have an Ivory color powder coat paint finish on all external surfaces.
- .4 Have tools available for field cutting and bending.
- .5 Assembly and disassembly of raceway base, cover, and fittings requiring no special tools.
- .6 Available fittings including couplings, internal and external elbows, tees, entrance fittings, conduit adapters and bushings.
- .7 Available fittings including internal, external and flat elbows, and tee fitting, with a 1 ½" radius to accommodate communications UTP and fiber cabling minimum bend radius requirements.
- .8 Installed fittings designed to overlap the raceway to cover exposed or uneven edges from field cutting.

2.04 Device Boxes

- .1 Compatible device boxes shall have a removable knockout portion to permit metal raceway entry and exit.
- .2 Device boxes available in standard NEMA single- and double-gang, and multiple gang up to six-gang. Device box depth shall range from 1.125" to 2.75".
- .3 Device boxes shall have a single seam construction with rounded corners to eliminate sharp edges.
- .4 Assembled device box front face design to permit flush mounting of standard wall plates to minimize perimeter profile exposure.
- .5 Device boxes shall have threaded standoff posts attached to the base, to facilitate mounting of covers with short screws for ease of alignment during installation.

3 Execution

3.01 Preparation

- .1 Submit layout drawings of the raceway system for reviewed prior to installation.
- .2 Installation of metal raceway in wet areas is not permitted.
- .3 Manufacturer's instructions for installing raceway and fittings shall be followed by the installer.
- .4 All wall surfaces, or other permanent structures to which raceway is mounted shall be finished complete.

3.02 Installation

- .1 Mount base and cover together to wall or structure using the appropriate fasteners and clips, per manufacturer's instructions.
- .2 Securely support raceway in intervals not exceeding 3 m (10 feet) or per manufacturer's instructions.
- .3 Install fittings and device boxes in the specified locations, per manufacturer's instructions and per contract drawing specifications.
- .4 Completed raceway installation shall be mechanically continuous and connected to all electrical outlets, device boxes, and enclosures with no gaps or exposed cuts.
- .5 Provide insulated ground wire for power raceways per OESC requirements. Raceway shall not be used as the primary ground path.
- .6 Prior to wire and cable installation, the raceway system shall be installed complete, including insulating bushings, adapters, fittings, outlets, boxes, and enclosures. Unused raceway openings shall be closed.
- .7 Make wiring connections with the proper approved insulated wire connectors or lugs. Exposed conductors at harness wiring junctions are not permitted regardless of connection method.
- .8 Provide a physical barrier in raceway and boxes to separate power and communication wiring.
- .9 Install covers on raceway, boxes and fittings after wiring is complete, or if wire and cable installation is to be done at a later date.

3.03 Field Quality Control

- .1 Verify layout of system to contract drawings.
- .2 Raceway system shall be free of dents, scratches, bare metal edges, and exposed uneven cuts.
- .3 Securely fasten all outlets, boxes, and enclosures walls or permanent structures.
- .4 Verify that all wiring junctions or connections have no exposed conductors prior to energizing the circuits.
- .5 Verify that all bonding locations are code and standards compliant.
- .6 Verify that power and communications wiring are separated by a physical barrier in raceway and boxes.

End of Section

1 General

1.01 Section Includes

- .1 This section provides minimum acceptance requirements for vibration isolation for all electrical equipment, conduit, and piping.

1.02 Related Requirements

- .1 Concrete work is described in Division 03.

1.03 Submittals

- .1 All vibration isolation systems shall be by one manufacturer.
- .2 All outdoor mounted equipment shall be restrained for the highest wind speed as specified by the project's structural engineer, the governing building code(s) or the authority having jurisdiction.
- .3 Submit shop drawings for all devices specified herein and as indicated and scheduled on the drawings. Submittals shall indicate full compliance with the device specification in Part 2. Any deviation shall be specifically noted and subject to engineer approval. Submittals shall include device dimensions, placement, attachment and anchorage requirements.

1.04 Quality Assurance

- .1 Unless otherwise directed by the local authority having jurisdiction, the following codes and standards will apply:
 - .1 International Building Code 2009
 - .2 American Society of Civil Engineers 7-05
 - .3 Ontario Building Code, Latest Edition

2 Products

2.01 Manufacturers

- .1 Vibro-Acoustics.
- .2 Kinetics Noise Control.
- .3 BVA Systems.
- .4 Vibron Limited.
- .5 Mason Industries.

2.02 Vibration Isolation

- .1 Springs: All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have k_x/k_y ratios of at least 0.9. All springs shall be fully color-coded to indicate capacity – color striping is not considered adequate.
- .2 Corrosion Protection: All springs shall be powder-coated enamel. Housings shall be hot dipped galvanized, powder-coated enamel, or painted with rust-resistant paint.
- .3 Isolators:
 - .1 Vibration Isolation Pads: Type N – Neoprene pad type isolators, 3/8" (10 mm) minimum thick, ribbed on both sides.

- .1 Type NSN – Sandwich neoprene pad type isolators, with 3/8" (10 mm) minimum thick ribbed neoprene pads bonded to each side of a 10 ga (3.5 mm) minimum galvanized metal plate. Isolator pads shall be selected to ensure that deflection does not exceed 20% of isolator free height.
- .2 Rubber-in-Shear Floor Mounts: Type RD – "Double-deflection" neoprene isolators, with neoprene-coated metal surfaces, and top and bottom surfaces ribbed. Isolators shall have bolt holes in the base.
- .3 Restrained Spring Floor Mounted Isolators: Type CSR – Laterally stable, vertically restrained spring isolators with welded steel housings and heavy top plates for supporting equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a ribbed neoprene pad, minimum 1/4" (6 mm) thick, bonded to the base plate. Housings shall include vertically restraining limit stops. Minimum clearance around the restraining bolts and between the housing and the spring shall be 1/2" (13mm). 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. For outdoor applications, housing must be hot-dip galvanized. For indoor applications, powder-coated finish for the housing is acceptable.

3 Execution

3.01 General

- .1 Coordinate size, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation manufacturer to ensure adequate space and prevent edge breakout failures. Pads and piers must be adequately doweled in to structural slab.
- .2 Coordinate locations and sizes of structural supports with locations of vibration isolators (e.g., roof curbs, cooling towers, air-cooled chillers, etc.).
- .3 Isolated equipment, duct and piping located on roofs must be attached to the structure. Intermediate supports between the restraint and structure that are not attached to the structure must be approved by the restraint manufacturer.

3.02 Vibration Isolation

- .1 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 anchors.
- .2 Select and locate vibration isolation equipment to give uniform loading and deflection, according to weight distribution of equipment.
- .3 Engine-generator set silencers and associated exhaust piping shall be supported with Type SHR isolators with a minimum 40 mm (1-1/2 inch) static deflection.
- .4 Equipment Isolation:

Equipment Type	HP and Other	RPM	Floor Span											
			Slab on Grade			Up to 20 ft.			20 to 30 ft.			30 to 40 ft.		
			Base Type	Isolat or Type	Min. Defl., in.	Base Type	Isolat or Type	Min. Defl., in.	Base Type	Isolat or Type	Min. Defl., in.	Base Type	Isolat or Type	Min. Defl., in.
Transformers														
All	All	All	N/A	NSN	0.12	N/A	NSN	0.12	N/A	NSN	0.12	NM	RD/N SN	0.25
Engine-Driven Generators														
All	All	All	N/A	CSR	0.75	N/A	CSR	1.50	N/A	CSR	2.50	N/A	CSR	3.50

Notes:	(1) Units that are suspended overhead shall use isolation hangers in place of floor mounted isolators with equal or greater deflection. (2) Floor spans are defined as the distance between structural support columns or walls.
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- .5 There shall be no rigid contact of isolated equipment with shaft walls, floor slabs, partitions, or non-flexible conduits connections.
- .6 Where recommended by the manufacturer, isolator base plates shall be bolted to the structure or foundation. Bolting shall incorporate neoprene bushings and washers.

3.03 Site Tests and Inspections

- .1 After installation, arrange and pay for the vibration isolation product manufacturer, or representative, to visit the site to verify that the vibration isolation systems are installed and operating properly, and shall submit a certificate so stating. Verify that isolators are adjusted, with springs perpendicular to bases or housing, adjustment bolts are tightened up on equipment mountings, and hangers are not cocked.

End of Section

1 General

1.01 Section Includes

- .1 Nameplates and labels.
- .2 Wire and cable markers.
- .3 Conduit markers.
- .4 Receptacle labels.
- .5 Signage.

1.02 Related Requirements

- .1 Section 27 05 53 – Identification for Communications Systems.

1.03 Submittals

- .1 Product Data: Provide catalogue data for nameplates, labels, and markers.
- .2 Provide shop drawings of nameplates for Consultant's review prior to fabrication (scale 1:1)
- .3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.04 Regulatory Requirements

- .1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

2 Products

2.01 Nameplates and Labels

- .1 Nameplates:
 - .1 Engraved three-layer laminated plastic, letters on contrasting background.
 - .2 Colours to match existing building system, where applicable. If no building system exists, use the following:
 - .1 347/600 Volt System: White text on Blue Background.
 - .2 120/208 Volt System: Black text on White Background.
 - .3 Fire Detection System: White text on Red Background.
 - .4 Emergency Lighting System: Red text on White Background.
 - .5 LV Systems: White text on Green Background.
 - .3 Confirm colours with Engineer prior to ordering nameplates.
- .2 Equipment Nameplates to indicate:
 - .1 Equipment/Panelboard ID

- .2 Ampacity.
- .3 Voltage
- .4 Number of Phases
- .5 Number of wires in system
- .6 Interrupting Capacity
- .7 Size, number of poles, Panelboard ID, and circuit number of upstream overcurrent protection device.
 - .1 Location of upstream device if not in the same room.
- .3 Coordination Study Labels to Section 26 05 73.16.
- .4 Arc Flash Study Labels to Section 26 05 73.19.
- .5 Locations:
 - .1 Distribution panelboards, and individual distribution panelboard branch breakers.
 - .2 Receptacle panelboards.
 - .3 Each electrical distribution and control equipment enclosure.
 - .4 Uninterruptible Power Supply.
 - .5 Mechanical Equipment.
 - .6 UPS Receptacles.
 - .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
 - .8 Terminal cabinets, junction boxes, and pull boxes: indicate system and voltage.
 - .9 Transformers: indicate capacity, primary and secondary voltages.
- .6 Letter Size:
 - .1 Use 3 mm letters for identifying individual equipment and loads.
 - .2 Use 6 mm letters for identifying grouped equipment and loads.
- .7 Labels:
 - .1 Mechanically fastened with sheet metal screws, with 5 mm white letters on black background.
 - .2 White letters on red background for UPS and equipment, and devices downstream of UPS.
 - .3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
 - .4 Wording on nameplates and labels to be approved by the Engineer prior to manufacture.
 - .5 Allow for minimum of twenty-five (25) letters per nameplate and label.
 - .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
 - .7 Terminal cabinets and pull boxes: indicate system and voltage.

2.02 Wiring Identification

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.03 Wire Markers

- .1 Description: tape, split sleeve, or tubing type wire markers.
- .2 Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.
- .3 Legend:
 - .1 Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
 - .2 Control Circuits: Control wire number indicated on shop drawings.

2.04 Conduit Markers

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Location: Provide markers for each conduit longer than 2 m.
- .3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .4 Colours to match equipment nameplate background colour:
 - .1 347/600 Volt System: Blue.
 - .2 120/208 Volt System: Black.
 - .3 Fire Alarm System: Red.
 - .4 Emergency Lighting System: Red/White.
 - .5 LV Systems (EPO, Remote Monitoring, Generator Control, Communications): Green.
 - .6 120/208 Volt Uninterruptable Power Supply (UPS): Orange
- .5 Confirm colours with Engineer prior to commencing rough-in.

2.05 Branch Breaker Labels

- .1 General:
 - .1 Legibly identify every circuit and circuit modification as to its clear, evident, and specific purpose or use. Include sufficient detail to allow each circuit to be distinguished from all others.
 - .2 Label spare positions that contain unused overcurrent devices or switches.
 - .3 Do not describe any circuit in a manner that depends on transient conditions of occupancy.
- .2 Switchboards, distribution panelboards, enclosed breakers, and disconnect switches:

- .1 Locate identification at each switch.
- .2 Branch breaker nameplates on switchboards, distribution panelboards and switchboards, and generator load breakers to indicate:
 - .1 Locate identification at each switch on a switchboard.
 - .2 Identification of downstream equipment fed from the breaker.
 - .1 Location of downstream device if not in the same room.
 - .3 Breaker size and number of poles.
 - .4 Interrupting Capacity.
 - .5 Circuit number (where applicable).
 - .6 Do not describe any circuit in a manner that depends on transient conditions of occupancy.
- .3 Lighting and Receptacle Panelboards:
 - .1 Provide a circuit directory that is located on the face or inside of the panel door.
 - .2 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

2.06 Receptacle Labels

- .1 Label all receptacles with the panelboard ID and circuit number.
- .2 Use receptacle labels by electronic labeller Brother P-Touch, model PT-20/25, Dymo-Tape or approved equal.
- .3 Location: On receptacle wall plate.

3 Execution

3.01 Equipment Nameplates from Manufacturers

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.
- .2 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.
- .3 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

3.02 Conduit Identification

- .1 Locate labels as follows:
 - .1 At every end of every conduit, duct or cable run, adjacent to item of equipment serviced.
 - .2 On each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall partition or floor).
 - .3 At intervals of 50'-0" along every exposed conduit, duct or cable run exceeding 50'-0" in length.
 - .4 At every access point on concealed conduit duct or cable.
- .2 Place labels so as to be visible from 5'-0" above adjacent floor platform.

3.03 Preparation

- .1 Degrease and clean surfaces to receive nameplates and labels.

3.04 Application

- .1 Confirm colours prior to start of work.
- .2 Install nameplate and label parallel to equipment lines.
- .3 Secure nameplate to equipment front using adhesive.
- .4 Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- .5 Identify conduit using field painting.
- .6 Paint coloured band on each conduit longer than 2 m.
- .7 Paint bands 6 m on centre.

3.05 Labelling

- .1 Colour code wiring consistently throughout the installation and generally match colour coding of internal wiring of pre-wired components.
- .2 Label wiring with point name using Thomas & Betts 12 character polestar metalized labels with 3 rows of characters per label, or equal by Brady. Label to occur as a minimum at both ends and at pull boxes of the wiring run.
- .3 Identify all pull boxes, junction boxes, etc. (installed as part of this project or used by this project) with the exact use of the box. Indelible felt pen marker is acceptable.
- .4 Label light control items with point name using Thomas & Betts 12 character label, or equal by Brady. Label to be black lettering on clear backing.
- .5 Label relays and controllers inside panels using Thomas & Betts 12 character label, or equal by Brady.
- .6 Provide red, 13 mm (1/2 inch) diameter, sticker on emergency light fixture frame. Include circuit number on sticker with thin permanent black mark pen.

3.06 Labels and Signs

- .1 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.
- .2 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

End of Section

1 General

1.01 Section Includes

- .1 The contractor shall provide an Arc Flash Hazard Analysis Study per the requirements described in CSA-Z462 Standard for Electrical Safety in the Workplace.
- .2 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are obtained in CSA-Z462-08, Annex D, or more recent of the standard as cited by this Section.
- .3 The scope of the studies shall include all existing distribution equipment and all new distribution equipment supplied by the equipment Manufacturer under this contract.

1.02 Related Requirements

- .1 Section 26 05 73.16 – Coordination Studies.
- .2 Single Line Diagram.

1.03 References

- .1 References
 - .1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - .1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - .2 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - .3 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - .4 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - .5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - .6 IEEE 1584-2018 - Guide for Performing Arc-Flash Hazard Calculations
 - .2 American National Standards Institute (ANSI):
 - .1 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 - .2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - .3 ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - .4 ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
 - .3 Ontario Electrical Safety Code (27th edition/2018).
 - .4 CSA Z462-15, Workplace electrical safety.

1.04 Submittals

- .1 Submit the protective device coordination study to the Consultant prior to receiving final review of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.05 Closeout Submittals

- .1 The results of the protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Three (3) bound copies of the complete final report shall be submitted. Additional copies of the complete report with input and output data shall be provided on CD in PDF format.
- .2 The report shall include the following sections:
 - .1 Executive Summary.
 - .2 Descriptions, purpose, basis and scope of the study.
 - .3 Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
 - .4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
 - .5 Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
 - .6 Details of the incident energy and flash protection boundary calculations.
 - .7 Recommendations for system improvements, where needed.
 - .8 Single Line Diagram.
- .3 Arc flash labels (refer to CSA Z462 Annex Q) shall be provided in hard copy only.

1.06 Qualifications

- .1 Arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- .2 The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.

1.07 Computer Analysis Software

- .1 The studies shall be performed using the latest revision of the SKM or equivalent.

2 Products

2.01 Manufacturers

- .1 Independent Testing Organizations:
 - .1 AC Tesla.
 - .2 Brosz and Associates.
 - .3 C-INTECH.

- .4 Eastenghouse.
- .5 Enkompass.
- .6 G.T. Wood.
- .2 Electrical distribution manufacturers:
 - .1 Eaton.
 - .2 Schneider Electric.

2.02 Studies

- .1 The contractor shall furnish an Arc Flash Hazard Analysis Study per CSA Z462, reference Section 4.1.8.2.2, 4.3.3.

2.03 Data Collection

- .1 Contractor shall furnish all data as required by the power system studies. The Engineer performing arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- .2 Source combination may include present and future motors and generators.
- .3 If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.04 Arc Flash Hazard Analysis

- .1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in CSA Z462 Annex D.
- .2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, panelboards and splitters) where work could be performed on energized parts.
- .3 The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 112.5 kVA where work could be performed on energized parts.
- .4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 calories per square centimetre.
- .5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- .6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- .7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - .1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.

- .8 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- .9 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- .10 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- .11 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- .12 Arc Flash calculations shall be based on actual overcurrent protective device clearing time.
- .13 Maximum clearing time will be capped at 2 seconds based on IEEE 1584.
- .14 Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.05 Report Sections

- .1 Incident energy and flash protection boundary calculations:
 - .1 Arcing fault magnitude.
 - .2 Protective device clearing time.
 - .3 Duration of arc.
 - .4 Arc flash boundary.
 - .5 Working distance.
 - .6 Incident energy.
 - .7 Hazard Risk Category.
 - .8 Recommendations for arc flash energy reduction.

3 Execution

3.01 Field Adjustment

- .1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- .2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- .3 Notify Owner in writing of any required major equipment modifications.

3.02 Arc Flash Warning Labels

- .1 The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 inch by 5 inch thermal transfer type label of high adhesion polyester for each work location analyzed.
- .2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- .3 The label shall include the following information, at a minimum:
 - .1 Location designation.
 - .2 Nominal voltage.
 - .3 Flash protection boundary.
 - .4 Hazard risk category.
 - .5 Incident energy.
 - .6 Working distance.
 - .7 Engineering firm and issue date.
 - .8 Labels shall be machine printed, with no field markings.
- .4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - .1 For each 600 volt, and applicable 208 volt panelboard, one arc flash label shall be provided.
 - .2 For each motor control center, one arc flash label shall be provided.
 - .3 For each low voltage switchboard, one arc flash label shall be provided.
 - .4 For each switchgear, one flash label shall be provided.
 - .5 For medium voltage switches one arc flash label shall be provided.
- .5 Arc Flash Warning Label General Instructions:
 - .1 Only qualified electricians who recognize and avoid the electrical and Arc Flash hazards are allowed to place the arc flash warning labels.
 - .2 Electricians should wear suitable PPE, such as electrical safety boots, Safety Glasses, etc. while performing labeling.
 - .3 Generally, arc flash label shall be put on a prominent pre-cleaned place on the front of the electrical equipment (such as switchgear, panel, disconnect switch, generator output breaker). Label should be visible and readable, displayed horizontally, attached flatly and securely, and not allowed to cover other signs or labels on the equipment.
 - .4 Under the special request of the client, labels could be put on the back of the panel door when the panel is located in clean and finished spaces such as an office area.
 - .5 When putting a label on small equipment with no space labeling on the wall just beside the equipment is allowed.
 - .6 Special request may be attached to this General Instruction. For examples, more than one identical label is applied for large equipment; different labels could be applied for different sections of one equipment; for a splitter with several disconnect switches only one label is placed on the splitter for this group.

- .7 Take the pictures for each label to indicate both names of the label and equipment and labeling area of the equipment. Email these pictures to the Consultant for quality control and record.

End of Section

1 General

1.01 Section Includes

- .1 Electrical connections to equipment specified in other sections.

1.02 Related Requirements

- .1 Division 08 – Openings.
- .2 Division 11 – Equipment.
- .3 Division 14 – Conveying Equipment.
- .4 Division 21 – Fire Suppression.
- .5 Division 22 – Plumbing.
- .6 Division 23 – Heating, Ventilating, and Air Conditioning.

1.03 References

- .1 NEMA WD 1 - General Colour Requirements for Wiring Devices.
- .2 NEMA WD 6 - Wiring Devices - Dimensional Requirements.

1.04 Coordination

- .1 Coordinate work to Section 01 31 00.
- .2 Obtain and review shop drawings, product data, and manufacturer's instructions for equipment provided under other sections.
- .3 Determine connection locations and requirements.
- .4 Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- .5 Sequence electrical connections to coordinate with start-up schedule for equipment.

1.05 Submittals

- .1 Submit to Section 01 33 00.
- .2 Product Data: Provide wiring device manufacturer's catalogue information showing dimensions, configurations, and construction.
- .3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.06 Regulatory Requirements

- .1 Provide products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

2 Products

2.01 Common Motor Requirements

- .1 Motors up to and including 1/3 HP, shall be 1 phase, 60 Hz, 120 volts.

- .2 Motors 1/2 HP and above shall be 3 phase, 60 Hz, 575 volts or 208 volts.

2.02 Cords and Caps

- .1 Attachment Plug Construction: Conform to NEMA WD 1.
- .2 Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
- .3 Cord Construction: NFPA 70, Type SJO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- .4 Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

3 Execution

3.01 Wiring of Equipment Provided Under Other Divisions

- .1 Use the following procedure with regard to wiring of motors and equipment provided under other Divisions.
- .2 The following equipment shall be responsibility of the trade supplying the equipment unless otherwise noted, in accordance with the requirements laid out in the individual section, or this division:
 - .1 Motors.
 - .2 Starters.
 - .3 Variable Frequency Drives.
 - .4 Motor Control Centres.
 - .5 Control wiring.
- .3 In every instance, install starter, motor control centre, variable frequency drivers (VFD), etc. and wire to line side of the starter, the Motor Control Centre, or VFD. Extend wiring from starter, motor control centre or VFD to motor as indicated.
- .4 Provide all wiring for starters and VFD's from supply to starter to VFD and to motor. Coordinate requirements with the appropriate trade.
- .5 Provide 500 mm of liquid tight flexible metal conduit for final connection to motor. Provide disconnect switches where required by code, and as indicated on the drawings.
- .6 Where individual starters and controls are grouped together provide a panel for mounting this equipment. Provide a feeder, main fused disconnect and a splitter of adequate size and capacity and wire to line side of the starters on this panel and from starters to motors.
- .7 Equipment, General
 - .1 Ascertain exact locations of starters, motor control centres, motors, etc. from drawings and coordinate exact locations with the supplying trade.
 - .2 Control wiring shall be the responsibility of the supplying trade.
 - .1 Control wiring shall be in accordance with Section 26 05 19, and Section 26 05 23.
 - .2 Control wiring shall be installed in conduit in accordance with Section 26 05 33.13.
- .8 Conveying Equipment (e.g. Elevators): in accordance with Section 26 05 83.14.

- .9 Plumbing Equipment
 - .1 Ascertain exact locations of starters, motor control centres, motors, infra-red plumbing fixture controls from Mechanical Drawings and coordinate exact locations with plumbing trade.
 - .2 Provide branch circuit wiring and an outlet for each infra-red plumbing fixture control.
 - .3 Control wiring shall be the responsibility of the plumbing trade, as described above.
- .10 HVAC Equipment
 - .1 Ascertain exact locations of starters, motor control centres, motors, motorized dampers, VAV boxes, and heating control valves from HVAC drawings and coordinate exact locations with HVAC Division.
 - .2 In the case of unit heaters, reheat coils and cabinet unit heaters, terminate wiring on terminals provided. Control wiring, thermostats, or other control devices shall be the responsibility of the HVAC trade, as described above.
 - .3 Provide branch circuit wiring and an outlet for each motorized damper, variable air volume (VAV) box, or heating control valve. Control wiring shall be the responsibility of the HVAC trade, as described above.

3.02 Examination

- .1 Verify that equipment is ready for electrical connection, wiring, and energization.

3.03 Electrical Connections

- .1 Make electrical connections to equipment manufacturer's instructions.
- .2 Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.
- .3 Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- .4 Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.
- .5 Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- .6 Install disconnect switches, controllers, control stations, and control devices as indicated.
- .7 Modify equipment control wiring with terminal block jumpers as indicated.
- .8 Provide interconnecting conduit and wiring between devices and equipment where indicated.
- .9 Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

End of Section

1 General

1.01 Section Includes

- .1 Commissioning of all building electrical systems and component including:
 - .1 Testing and adjustment.
 - .2 Demonstration and training.
 - .3 Instructions of all procedures for Owner's personnel.
 - .4 Updating as-built data.
 - .5 Co-ordination of Operation and Maintenance material.
- .2 Provide labour and material to conduct the commissioning process as outlined in this specification section, including the hiring of an Independent Testing Contractor (ITC) as detailed below.
- .3 Provisions of this section shall apply to all sections of Division 26, Division 27, Division 28, and sections related to electrical utilities in Division 33.

1.02 Related Requirements

- .1 Testing and commissioning are called for throughout the individual specifications. This does not relieve this trade from providing all testing and commissioning necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.
- .2 Section 26 08 50 – Commissioning of Lighting: additional commissioning requirements for commissioning of lighting and lighting controls.

1.03 Commissioning Process Allocation

- .1 The commissioning process shall be allocated a value equal to 5 per cent of the contract. The Electrical Contractor may draw from this allocation as the commissioning process is completed.
- .2 The Electrical Contractor shall submit all test and verification forms. The Consultant will use these forms to calculate percentage complete.
- .3 The Electrical Contractor may claim up to 3 per cent of the contract from this allocation leading up to performance testing. The remaining 2 per cent shall not be paid out until the performance testing, O&M manuals, and training have been completed satisfactorily.

1.04 Definitions

- .1 Cx – Commissioning.
- .2 Commissioning Authority
 - .1 The Commissioning Authority (CxA), also referred to as the Commissioning Consultant, shall be hired by The Owner.
 - .2 The CxA responsibilities shall include:
 - .1 preparing the commissioning plan
 - .2 co-ordinating with the contractor to schedule tests
 - .3 preparing a test form manual

- .4 witnessing selected tests
- .5 receiving all test forms
- .6 co-ordinating the contractors training
- .7 chair the commissioning meetings
- .3 The Electrical Contractor shall co-operate with the CxA.
- .4 The Electrical Contractor shall provide assistance to the CxA and have personnel available during the performance testing procedure. Each electrical system shall be tested in the operational mode.

1.05 Submittals

- .1 Conform to Section 01 33 00 for requirements for shop drawings and record drawings.
- .2 A commissioning document shall be prepared by the CxA prior to conducting these activities for use by the Commissioning Team.
- .3 The electrical sub-contractor shall be responsible for ensuring all activities are properly documented in this manual and co-ordinated through the General Contractor.
- .4 As-built drawings and data books must be available two weeks prior to commissioning for review and use by the consultant and Commissioning Team prior to the start of the commissioning activities.

1.06 Closeout Submittals

- .1 Attendance records for all training sessions.
- .2 Testing reports for system load balance measurements, infra-red test and harmonics tests.

1.07 Quality Assurance

- .1 Provide qualified trades persons, certified testing agencies, factory trained and approved by the Commissioning Team Leader.
- .2 Submit the names of all personnel to be used during the Commissioning activities.

1.08 Warranty

- .1 Equipment and system warranties shall not begin until the system demonstration and turnover has been conducted successfully and accepted by the Owner.
- .2 The Electrical Contractor shall fill out the warranty form listing the equipment and systems and the start and finishing dates for warranty.
- .3 Refer to Division 01 and Section 26 05 00 for the requirements during the warranty period.

2 Products

2.01 Equipment

- .1 The Contractor and manufacturers shall provide all instrumentation and equipment necessary to conduct the tests specified. The Contractor shall advise the Consultant of instrumentation to be used and the dates the instruments were calibrated.

3 Execution

3.01 The Commissioning Process

- .1 The purpose of the commissioning process is to fully test all building systems including architectural, mechanical and electrical components and operating procedures by challenging these systems to realistic operation conditions.
- .2 The commissioning process consists of:
 - .1 Shop Drawings and Record Drawings
 - .2 Installation inspection and equipment verification
 - .3 Independent testing contractor
 - .4 Testing of equipment and systems
 - .5 Commissioning meetings
 - .6 Operating and maintenance manuals
 - .7 Operating training
 - .8 Commissioning Agent testing
 - .9 Systems Demonstration and turnover
 - .10 Testing forms
 - .11 Warranties

3.02 Preparation

- .1 Provide test instruments required for all activities as defined in the commissioning documents.
- .2 Verify all systems are in compliance with the requirements of the commissioning documents prior to the pre-commissioning check out operation.
- .3 Confirm all scheduled activities have identified personnel available.
- .4 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

3.03 System Description

- .1 Perform all start-up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined in the commissioning documentation.
- .2 Owner will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.
- .3 Prepare and insert additional data in the operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the commissioning exercise.
- .4 Where instruction is specified in the commissioning manual, instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .5 Conduct presentation on Owner's premises. Owner will provide space.

3.04 Commissioning

- .1 Commission the components of the electrical system using the NETA Acceptance Testing Specifications.
- .2 Refer to the project commissioning plan prepared by the CxA.
- .3 Commissioning activities for the electrical systems must have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.
- .4 Contractor shall be responsible to update all documentation with information and any changes duly noted during the Commissioning exercise.
- .5 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification. The cost associated with this requirement shall be included as part of the tender price.

3.05 Final Report

- .1 This trade shall assemble all testing data and commissioning reports and submit them to the General Contractor for submission to the Owner.
- .2 Each form shall bear signature of recorder, and that of supervisor of reporting organizer.

3.06 Schedule of Activities

- .1 Commissioning activities shall be conducted based on pre-established schedule with all members of the commissioning team.
- .2 In addition, there will be two meetings held through the contract duration to introduce the parties of the commissioning team, establish the schedules and deadlines for the various activities and review the Commissioning Manual.
- .3 Adhering to the established schedule is very important as the co-ordination and scheduling of the participants will be difficult to alter once this is established. Close co-ordination of this schedule is important.
- .4 In the event project cannot be commissioned in the allotted time slot, the contractor shall pay for all costs associated with assembling the Commissioning Team at a later date. If the contractor has not performed his duties to reach commissioning stage as outlined earlier, he will incur all expenses of other trades and the Commissioning Team due to his non-compliance.

3.07 Installation Inspection and Equipment Verification

- .1 The Electrical Contractor shall co-ordinate with the Electrical Consultant who will inspect the electrical installation.
- .2 The Electrical Contractor shall complete the equipment verification forms for each piece of equipment. The forms shall be included in the operating and maintenance manual. The equipment data shall include:
 - .1 Manufacturers name, address and telephone number.
 - .2 Distributors name, address and telephone number.
 - .3 Make, model number and serial number.
 - .4 Voltage and current ratings.

3.08 Independent Testing Contractor

- .1 The Independent Testing Contractor (ITC) shall be hired by the contractor and shall issue reports to the Electrical Consultant.
- .2 The ITC shall conduct load balancing measurements to verify load balancing performed in accordance with Section 26 05 00.

3.09 Testing of Equipment and Systems

- .1 The Electrical Contractor shall be responsible for all tests detailed in this Section, and those tests required by a manufacturer as part of their installation requirements.
- .2 The Electrical Contractor shall schedule all tests which shall be witnessed by the Electrical Consultant or the Commissioning Consultant. The contractor shall complete and sign the testing forms.
- .3 The Electrical Contractor shall conduct tests on the following equipment as a minimum. Refer to the individual specification sections for test procedures.
 - .1 Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
 - .2 Section 26 05 73.16 – Coordination Studies.
 - .3 Section 26 24 13 – Switchboards.
 - .4 Section 26 24 16 – Panelboards.
 - .5 Section 26 24 19 – Motor Control Centres.
 - .6 Section 27 51 16 – Public Address Systems.
 - .7 Section 28 10 00 –Access Control.
 - .8 Section 28 46 21.11 – Addressable Fire Alarm Systems.
- .4 When all testing has been completed and all mechanical and electrical systems are operational the contractor shall conduct system load balance measurements, infra-red test and harmonics tests.

3.10 Commissioning Meetings and Reporting

- .1 The Electrical Contractor shall include the schedule for all tests in the construction schedule.
- .2 The Commissioning meetings shall occur during the regular construction meetings. The testing schedules and the results of all tests shall be reviewed.
- .3 All testing forms and reports associated with the electrical systems shall be directed to the Electrical Consultant, with copies to the Architect, Commissioning Consultant, and the Owner.
- .4 The forms and reports to be issued shall include:
 - .1 Shop drawings, issued and accepted
 - .2 Equipment verification forms
 - .3 Testing forms
 - .4 Reports resulting from tests
 - .5 Testing schedule
 - .6 Minutes of commissioning meetings
 - .7 Manufacturers' Certificates

3.11 Operating and Maintenance Manual

- .1 Conform to the specification section for the requirements of the O&M manuals.

3.12 Closeout Activities

- .1 Conform to section for requirements for instructions to the Building Owner for each system and equipment.
- .2 The training shall be provided by qualified technicians or electricians and shall be conducted in a classroom and at the equipment or system.
- .3 The training sessions shall be scheduled, co-ordinated and video taped by the Commissioning Consultant.
- .4 Each training session shall be structured to cover:
 - .1 The operating and maintenance manual.
 - .2 Operating procedures.
 - .3 Maintenance procedures.
 - .4 Troubleshooting procedures.
 - .5 Spare parts.
- .5 Submit a course outline to the Electrical Consultant before training commences. Provide course documentation for up to eight people.
- .6 The training session shall be scheduled and co-ordinated by the Commissioning Consultant. The Commissioning Consultant shall video tape the sessions.
- .7 Training shall be provided for the following systems:
 - .1 Electrical Systems including distribution and lighting: 8 hour minimum
 - .2 Section 27 51 16 – Public Address Systems: 1 hour minimum
 - .3 Section 28 10 00 – Access Control: 1 hour minimum
 - .4 Section 28 46 21.11 – Addressable Fire Alarm Systems: 2 hours minimum
- .8 The Electrical Contractor shall conduct a walkthrough of the installation. During the walkthrough the Electrical Contractor shall:
 - .1 Identify equipment.
 - .2 Identify electrical panels.
 - .3 Identify starters and disconnects.
 - .4 Review the electrical power distribution.
 - .5 Review the light power distribution.
 - .6 Review the switchgear.
 - .7 Review the general maintenance procedures.

3.13 The Electrical System Demonstration and Turnover

- .1 The system demonstration and turnover to The Owner shall occur when:
 - .1 The installation is complete.
 - .2 The acceptance test conducted by the Electrical Consultant has been completed successfully.

- .3 Training has been completed.
 - .4 Equipment Operating and Maintenance Manuals have been accepted.
 - .5 System operating manuals have been accepted.
 - .6 Shop-drawings have been updated.
 - .7 As-built drawings have been completed.
 - .8 The commissioning process has been completed successfully and system operation accepted by the Electrical Consultant and Commissioning Consultant.
- .2 The systems demonstration shall be conducted by the Electrical Contractor and manufacturers. The demonstration shall cover a physical demonstration of equipment installation and operation.

3.14 Testing Forms

- .1 The Electrical Contractor and manufacturers shall fill out the forms listed in this section or provide other forms. The forms must be approved by the Electrical Consultant and the Owner before they are used.

End of Section

1 General

1.01 Section Includes

- .1 Common requirements for commissioning of all electric lighting, including interior, exterior, and emergency lighting.
- .2 The party responsible for the functional testing shall not be directly involved in either the design or construction of the project.

1.02 Related Requirements

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 09 26 – Lighting Control Panelboards.
- .3 Section 26 09 43 – Network Lighting Controls.
- .4 Section 26 51 00 – Interior Lighting.
- .5 Section 26 52 13.13 – Emergency Lighting.
- .6 Section 26 56 19 – LED Exterior Lighting.

1.03 References

- .1 ASHRAE
 - .1 ASHRAE Guideline 0-2005 – The Commissioning Process.
 - .2 ASHRAE 90.1-2013 – Energy Standard for Building Except Low-Rise Residential Buildings.
- .2 Illumination Engineering Society (IES)
 - .1 IES DG-29-11 – Design Guide for the Commissioning Process Applied to Lighting and Control Systems.
- .3 Ontario Building Code
 - .1 Supplementary Standard SB-10: Energy Efficiency Requirements, December 22, 2016 update.

1.04 Action Submittals

- .1 Refer to Section 01 33 00.
- .2 Submit sample commissioning forms.

1.05 Closeout Submittals

- .1 Section 01 33 00 and Section 01 78 00: Submittals for project closeout.
- .2 Submit commissioning reports.
 - .1 Submit a floor plan or spreadsheet table checklist that indicates each local lighting control device, occupancy sensors, daylighting controls, system component.
 - .2 Submit the system sequence of operation fully describing the equipment components and functionality, including set points and alarm functions.
 - .3 The detailed sequence of operation shall be provided regardless of the completeness and clarity of the sequences in the controls specification and/or drawings.

- .3 The functional testing party shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.

2 Products – Not Used

3 Execution

3.01 Site Tests and Inspections

- .1 Sensor placement and orientation for all sensor types.
- .2 Occupancy sensor function, sensitivity, and time delays.
- .3 Daylight harvesting sensor calibration.
- .4 Automated shade operation.
- .5 Manual control placement and operation.
- .6 Automated control operation, including scheduled on/off functions and dimming trims and presets.
- .7 Override operation, access, and functionality.
- .8 Centralized control interfaces and operation.
- .9 Client education of operations.
- .10 Documentation archived to client.

3.02 Functional Testing

- .1 Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions.
- .2 When occupant sensors, time switches, programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed:
 - .1 Confirm that the placement, sensitivity and time-out adjustments for occupant sensors yield acceptable performance, lights turn off only after space is vacated and do not turn on unless space is occupied.
 - .2 Confirm that time switches and programmable schedule controls are programmed to turn the lights off.
 - .3 Confirm that photosensor controls reduce electric lights levels based on the amount of usable daylight in the space as specified.

End of Section

1 General

1.01 Section Includes

- .1 Occupancy and Vacancy sensors.
- .2 Power packs, and auxiliary relays, momentary switches.
- .3 Manual controls devices, including dimming switches and low voltage momentary switches.
- .4 Timer switches.
- .5 Daylight harvesting photo sensors.
- .6 Emergency lighting control units.

1.02 Products Installed But Not Supplied Under This Section

- .1 Line voltage manual control devices, as described in Section 26 27 26 – Wiring Devices.
- .2 Multi-zone scene controllers, as described in Section 26 09 36 – Modular Dimming Controls.

1.03 Related Requirements

- .1 Section 26 08 50 – Commissioning of Lighting.
- .2 Section 26 27 26 – Wiring Devices.
- .3 Section 26 50 00 – Lighting.

1.04 References

- .1 Canadian Standards Association (CSA) (www.csa.ca).
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 14 Industrial Control Equipment
 - .4 CSA C22.2 No. 184 - Solid-State Lighting Controls
 - .5 CSA C22.2 No. 184.1 - Solid State Dimming Controls.
 - .6 CSA C22.2 No. 156 - Solid-State Speed Controls
 - .7 CSA C22.2 No. 42.1 - Cover Plates for Flush Mounted Wiring Devices
 - .8 CSA C22.2 No. 42 - General Use Receptacles
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 WD1 (R2005) — General Color Requirements for Wiring Devices.
 - .2 WD6 – Dimensional Specifications
- .3 Ontario Building Code.
- .4 UL 924 - Standard for Safety of Emergency Lighting and Power Equipment.

1.05 Submittals

- .1 In accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's descriptive literature and product specifications for each product.
 - .2 Manufacturer's product drawings.
 - .3 Manufacturer's installation instructions

1.06 Quality Assurance

- .1 Manufacturer Qualifications: Products free of defects in material and workmanship.

1.07 Warranty

- .1 Product is warranted free of defects in material and workmanship.
- .2 Product is warranted to perform the intended function within design limits.

2 Products

2.01 Manufacturers

- .1 Wattstopper (Basis of Design).
- .2 Cooper Lighting Solutions.
- .3 Hubbell.
- .4 Leviton.
- .5 Lutron.
- .6 Sensorswitch.

2.02 General Requirements of all Sensors and Power Packs

- .1 Manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1 per cent.
- .2 Five year warranty and CUL listed.
- .3 In the event of failure, provide a bypass manual "override on" feature on each sensor.
- .4 When bypass utilized, lighting to remain on constantly, or control is to be diverted to a wall switch until sensor is replaced. The override feature is to be designed for use by building maintenance personnel and not be readily achieved by building occupants.

2.03 Occupancy and Vacancy Sensors

- .1 General:
 - .1 Sensors using passive infrared, ultrasonic, microphonic, and multi-technology adaptive technology.
 - .2 Sensor timeouts configurable by system software.
 - .3 Electrical: Rating: 24 VDC input voltage, up to 40 mA current draw.

- .4 Mechanical: Mounting: Sensors for mounting on ceilings and walls, including corners, must be available.
- .5 Environmental:
 - .1 Operating Temperature Range: 0 degrees C to 40 degrees C
 - .2 Relative Humidity: 0 per cent to 95 per cent non-condensing.
- .2 Dual Technology Wall Switch Sensor, 24V
 - .1 Wattstopper DW-100-24-W series (Basis of Design).
 - .2 Sensor capable of detecting presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes.
 - .3 Utilize a dual sensing verification principle for coordination between ultrasonic and Passive Infrared (PIR) Technologies to reduce likelihood of false triggering.
 - .4 For best results, sensor shall feature a trigger mode where the end-user can choose which technology will activate the sensor from Off mode (initial), the type of detection that will reset the time delay (maintain), and the type of detection that will cause the sensor to be turned back on immediately after the lights are turned off due to lack of motion (re-trigger). Selection of technologies for initial, maintain, and re-trigger shall be done with DIP switches.
 - .5 Sensor shall have its trigger mode factory preset to allow for quick installation in most applications. In this default setting, both technologies must occur in order to initially activate lighting systems. Detection by either technology shall maintain the lighting on, and detection by either technology shall turn lights back on after lights were turned off for 5 seconds or less in automatic mode, and 30 seconds or less in manual mode.
 - .6 Robotic test method, as referred in the NEMA WD 7 Guide, shall be utilized for minor motion coverage verification.
 - .7 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 kHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
 - .8 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall filter short wavelength IR, such as those emitted by the sun and other visible light sources. Face lens grooves in to avoid dust and residue build up which affects IR reception.
 - .9 Utilize zero crossing circuitry to reduce stress on relay, and therefore increase sensor life.
 - .10 Operate at 24 VDC and halfwave rectified and utilize a power pack or lighting control system input module to supply power.
 - .11 To blend in aesthetically, sensor protrusion not more than 3/8" from the wall and utilize colour-matched lens.
 - .12 To assure detection at desktop level uniformly across the space, sensor shall have a 28 segment, 2 level, Fresnel injection molded lens.
 - .13 Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds, set by DIP switch.
 - .14 To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
 - .15 Coverage up to 1,000 sq. ft. for walking motion, with a field view of 180 degrees.
 - .16 Automatic-ON or manual-ON operation, adjustable with a DIP switch.
 - .17 Sensor shall have an adjustable time delay.

- .18 Each sensing technology shall have an LED indicator that remains active at all times, in order to verify detection within the area to be controlled.
 - .19 Sensor shall have a service switch to allow end-users to operate the sensor in the unlikely event of a failure; set by a trim pot.
 - .20 Sensor shall have a built-in light level that features simple, one-step daylighting setup that works from 8 fc to 180 fc.
 - .21 The Dual Technology wall switch sensor shall be a completely self-contained control system that replaces a standard toggle switch
- .3 Dual Technology Ceiling Mounted Sensor, 24V
- .1 Wattstopper DT-300 series (Basis of Design).
 - .2 The Dual Technology sensor shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
 - .3 Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic or microphonic and Passive Infrared (PIR) Technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either technology shall keep the lighting on.
 - .4 Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
 - .5 Sensors shall be ceiling mounted with a flat, unobtrusive appearance, and provide 360 degree coverage.
 - .6 Ultrasonic sensing shall be volumetric in coverage, with a frequency of 40 kHz. It shall utilize Advanced Signal Processing that automatically adjusts the detection threshold dynamically to compensate for changing levels of activity and airflow throughout a controlled space.
 - .7 To avoid false ON activations, and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, in order to respond only to those signals caused by human motion.
 - .8 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
 - .9 Sensors shall operate at 24 VDC, and halfwave rectified, and utilize a 24 V power pack.
 - .10 Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
 - .11 The sensor shall have a built-in light level sensor that works from 10 fc to 300 fc.
 - .12 The sensors shall feature terminal style wiring.
 - .13 Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less sensor visibility.

2.04 Special Purpose Occupancy Sensors

- .1 Occupancy Sensors for High bay applications:
 - .1 For use in warehouses, distribution centers, and gymnasiums.
 - .2 Maximum 14 m (45 feet) mounting height.

- .3 Surface-mount or end-mount model to suit application.
- .4 180 degree and 360 degree coverage lenses available.
- .5 Low-voltage, passive infrared (PIR) sensor.
- .6 End-mount model to attach directly to industrial T5HO and T8 fixtures through an extended 13 mm (0.5 inch) chase nipple or junction box.
- .7 Adjustable timeout for maximum energy savings.
- .8 Basis of design: Lutron LUT-WSPSM24V-360-CPN6111 and similar.

2.05 Power Packs

- .1 General:
 - .1 Self-contained transformer and relay module.
 - .2 Internal relay controlling up to 20A for 120, 230, 277VAC or 347VAC ballast loads and 120VAC incandescent loads.
 - .3 Provide a 24 VDC, 150 mA output.
 - .4 Capable of parallel wiring without regard to AC phases on primary.
 - .5 Power pack can be used as a standalone, low voltage switch, or can be wired to sensor for auto control.
 - .6 Construction: high impact, UL rated plastic case
 - .7 Power pack shall be UL/CUL Listed, FCC Certified, UL 2043 plenum rated and meets ASHRAE 90.1 requirements
 - .8 Shall at minimum meet the following environmental specifications:
 - .1 Operating Temperature Range: 0 degrees C to 40 degrees C
 - .2 Relative Humidity: 0 per cent to 95 per cent non-condensing
- .2 Power Pack and Auxiliary Relay, 347 V
 - .1 Power Pack: Wattstopper B347D-P Series (Basis of Design)
 - .2 Auxiliary Relay: Wattstopper S347-E-P Series (Basis of Design)
 - .3 Power pack shall be a self-contained transformer and relay module measuring 45 mm by 70 mm by 38 mm (1.75 inch by 2.75 inch by 1.5 inch).
 - .4 For ease and speed of installation, power pack shall have 12 mm (1/2") snap-in nipple for 12 mm (1/2") knockouts and mounting on outside of enclosure.
 - .5 Power pack shall have dry contacts capable of switching 15 amp ballast @ 347 VAC, 60Hz.
 - .6 Power pack shall have primary voltage input of 347 VAC.
 - .7 Power pack shall provide a 24 VDC, 114 mA output, with the relay connected.
 - .8 Power pack shall be capable of parallel wiring without regard to AC phases on primary.
 - .9 Power pack can be used as a standalone, low voltage switch, or can be wired to sensor for auto control.

- .10 Power pack shall have hold-ON and hold-OFF inputs for integration with lighting control panels, BMS and other building systems.
- .11 Power pack shall have overcurrent protection if the low voltage current drawn exceeds 150 mA. In the event of an overcurrent, the low voltage output current shuts down and the LED will blink to indicate a fault condition.
- .12 Power pack shall have an LED to indicate status of relay.
- .13 Power pack shall utilize Zero Crossing Circuitry to protect from the effects of inrush current and increase product longevity.

2.06 Dimming Switches

- .1 Direct control of dimming luminaires up to the luminaire manufacturer's specified rating.
- .2 Coordinate dimming signal configuration (2-wire phase cut, 3-wire, 4-wire 0-10V, or 4-wire DALI) with the fixture ballast or driver per Section 26 50 00, lighting fixture schedule, and related sections.
- .3 Compatible with related lighting control devices i.e. occupancy sensors.
- .4 Submit luminaire manufacturer's dimmer compatibility documentation to demonstrate compatibility and limits of dimming level.
- .5 Acceptable Manufacturers:
 - .1 Lutron NovaT* style dimmers.
 - .2 Equal by Cooper.
 - .3 Equal by Philips.
 - .4 Approved Equal.

2.07 Sequences of Operation

- .1 Vacancy Sensor Operation: Manual On, Manual/Auto Off.

3 Execution

3.01 Installation

- .1 In accordance with manufacturer's instructions.
- .2 Minimum 14 AWG from the circuit control hardware relays.
- .3 It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.
- .4 It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at Owner's facility, to verify placement of sensors and installation criteria.
- .5 Proper judgement must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.
- .6 Install manual control devices and sensors in accordance with manufacturer's instructions for Vacancy Operation.

3.02 Training

- .1 Provide training in accordance with Section 01 79 00.

3.03 Site Tests and Inspections

- .1 In accordance with Section 26 08 50.
- .2 Upon completion of the installation, the system shall be completely commissioned to verify all adjustments and sensor placement to ensure a trouble-free lighting control system.
- .3 Submit commissioning report to the Consultant and the commissioning authority for review.
- .4 Provide the Consultant and Commissioning Authority with ten working days written notice of the scheduled commissioning date.

End of Section

1 General

1.01 Section Includes

- .1 Metering transformer cabinets.
- .2 Meter bases.
- .3 Utility Requirements.
- .4 A new service will be provided from a new padmount transformer, built to the requirements of the Local Hydro Authority as per the Standard Details.

1.02 Related Requirements

- .1 Section 26 24 13 – Switchboards: Metering transformer compartment.

1.03 References

- .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (27th edition/2018).
- .3 Ontario Building Code and its referenced standards.
- .4 CSA C22.2 No. 52 - Underground Service-Entrance Cables

1.04 Pre-Installation Meetings

- .1 Convene one week prior to commencing work of this section.
- .2 Review service entrance requirements and details with utility company's representatives.

1.05 Action Submittals

- .1 Product Data: Provide ratings and dimensions of transformer cabinets and meter bases.

1.06 Informational Submittals

- .1 Submit utility company's prepared drawings.

1.07 Quality Assurance

- .1 Perform Work to utility company's written requirements.
- .2 Obtain approval from Supply Authority and Inspection Authority on complete service. Coordinate work with Utility.
- .3 Maintain one copy of each document on site.

1.08 Regulatory Requirements

- .1 Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2 Products

2.01 Description

- .1 Electric Utility Company: Waterloo North Hydro.

- .2 System Characteristics: 400 amps, 600Y/347 volts, 3-phase, 4-wire.
- .3 Available Fault Current: [] kA.

2.02 Metering Transformer Cabinet

- .1 Manufacturers: As per Utility Requirements
- .2 Description: Sheet metal cabinet with hinged door, conforming to utility company requirements, with provisions for locking and sealing.
- .3 Dimensions: 48 inch wide by 48 inch high (depth to suit Hydro requirements).

2.03 Meter Bases

- .1 Meter Base: Provided by utility company.

2.04 PT's and CT's

- .1 Supplied by the utility for inclusion in main switchboard.

3 Execution

3.01 Verification of Conditions

- .1 Verify that field measurements are as indicated on utility company's drawings.

3.02 Preparation

- .1 Arrange with utility company to obtain permanent electric service to the project.

3.03 Installation

- .1 Local Hydro Authority will provide transformer and reconnect existing primary and secondary cabling to new transformer. Existing underground secondary ductbank, cabling and foundation grounding grid to remain.
- .2 Utility Metering (Supplied by Local Hydro Utility)
 - .1 Current and potential transformers for utility metering shall be in accordance with requirements of Supply Authority.
 - .2 Equipment manufacturer shall submit complete metering details for approval to utility and obtain their approval prior to manufacture.
 - .3 Compartment housing utility metering transformers shall be suitable for utility padlocking.
- .3 Metering Instruments
 - .1 A flush mounted voltmeter and a flush mounted ammeter, along with three phase selector switches and associated metering transformers shall be provided.
- .4 Work of this and related requirements
 - .1 Provision of concrete encased primary and secondary ducts, transformer vault to Local Hydro Authority requirements. Provision of fish wire in primary ducts.
 - .2 Provision of feeder from transformer to main switch.
 - .3 Grounding installation.

- .5 Work by the Local Hydro Authority
 - .1 Termination of primary cables at transformer.
 - .2 Provision of transformer.
 - .3 Provision of all equipment at property line.
 - .4 Termination of medium voltage cables at both ends with stress cones.
 - .5 Termination of secondary cables and ground cable(s) at transformer.
- .6 Service Entrance
 - .1 Connect to service entrance breaker as shown and as specified.
 - .2 Provide incoming and outgoing cable connections, torque same as required.
 - .3 Ground equipment as required by Code.
- .7 Provide complete shop drawings for all distribution equipment. Local Hydro Authority will provide high voltage cable and transformer. Primary duct, transformer vault, secondary duct, secondary cable, grounding etc., to be provided by this Contractor.

End of Section

1 General

1.01 Section Includes

- .1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.02 References

- .1 ANSI/ASHRAE/IES Standard 90.1-2013 -- Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Canadian Standards Association (CSA):
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CAN/CSA C22.2 No. 47-13 (R2018), Air-cooled transformers (dry type).
 - .4 CSA C9-17, Dry-type transformers.
 - .5 CSA C802.2-18 Minimum Efficiency Values for Dry-Type Transformers.
- .3 National Electrical Manufacturers Association (NEMA):
 - .1 NEMA ST-20 for Sound Level.
- .4 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).
- .5 Ontario Building Code and its referenced standards.

1.03 Action Submittals

- .1 Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, power, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.04 Informational Submittals

- .1 Test Reports: Indicate loss data, efficiency at 25, 50, 75, and 100 per cent rated load, and sound level.
- .2 Submit manufacturer's installation instructions.
 - .1 Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.
 - .2 Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 Closeout Submittals

- .1 Record actual locations of transformers in project record documents.

1.06 Delivery, Storage, and Handling

- .1 Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from potential damage from weather and construction operations.
- .2 Store so condensation will not form on or in the transformer housing and if necessary, apply temporary heat where required to obtain suitable service conditions. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

- .3 Handle to manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.
- .4 Handle transformer using proper equipment for lifting and handling, use when necessary lifting eye and/or brackets provided for that purpose.

1.07 Warranty

- .1 The transformer shall carry a 2 year warranty from the time of substantial performance.

2 Products

2.01 General

- .1 Transformers shall be standard general purpose dry type unless otherwise indicated on drawings as K-Rated or Harmonic Mitigation type.
- .2 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA-C22.2 No.47 and CSA C9.

2.02 Manufacturers

- .1 STI.
- .2 Delta Transformer.
- .3 Eaton.
- .4 Hammond.
- .5 Powersmiths.
- .6 Rex Power Magnetics.
- .7 Siemens.
- .8 Schneider Electric.

2.03 Regulatory Requirements

- .1 Products: Listed and classified by CSA (Canadian Standards Association).
- .2 Efficiency ratings:
 - .1 Meet or exceed the efficiency levels indicated in CSA C802.2-12, and ASHRAE 90.1, Table 8.1.

2.04 General Purpose Transformers

- .1 NEMA ST-20, factory-assembled, air cooled low-inrush dry type transformer, ratings and voltages as indicated on drawings.
- .2 Single or three phase as indicated on drawings.
- .3 Type: AN/AA Ventilated self-cooled.
- .4 Copper windings.
- .5 Finish: Final coating to be ASA 61 Grey Epoxy Powder
- .6 T-connected transformers are not acceptable.

- .7 Isolate core and coil from enclosure using vibration-absorbing mounts.
- .8 Impedance: Standard.

2.05 Primary Voltage

- .1 600 volts delta, 3 phase;

2.06 Secondary Voltage

- .1 120/208 volts, 3 phase wye.

2.07 Insulation System and Average Winding Temperature Rise

- .1 1-15 kVA: Class 185 with 80 degrees C rise.
- .2 16-500 kVA: Class 220 with 80 degrees C rise.
- .3 Above 500 kVA: Class 220 with 80 degrees C rise.

2.08 Case Temperature

- .1 Do not exceed 35 degrees C rise above ambient at warmest point at full load.

2.09 Winding Taps

- .1 To NEMA ST-20.
- .2 Four full capacity 5 per cent adjustment taps, 2 at 2.5 per cent FCBN (full capacity below nominal) and 2 at 2.5 per cent FCAN (full capacity above nominal).

2.10 Basic Impulse Level

- .1 10 kV BIL.

2.11 Grounding

- .1 Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

2.12 Mounting

- .1 1-15 kVA: suitable for wall mounting.
- .2 16-75 kVA: suitable for wall or floor, as shown.
- .3 Larger than 75 kVA: suitable for floor mounting.

2.13 Coil Conductors

- .1 Continuous windings with terminations brazed or welded.

2.14 Enclosure

- .1 NEMA ST-20, CSA, Type 2 ventilated, Sprinkler-proof. Provide lifting eyes or brackets.

2.15 Sound Levels

- .1 To NEMA ST-20 for transformers up to 300 kVA:
 - .1 Up to 9 kVA: 40 dB.

- .2 10 – 50 kVA: 45 dB.
- .3 51 – 150 kVA: 50 dB.
- .4 151 – 300 kVA: 55 dB.
- .2 Sound levels 3 db less than NEMA ST-20 for transformers 301 kVA and greater.
 - .1 301 – 500 kVA: 57 dB.
 - .2 501 – 700 kVA: 59 dB.
 - .3 701 – 1000 kVA: 61 dB.
 - .4 Above 1000 kVA: 3 db less than NEMA ST-20.

2.16 Nameplate

- .1 Transformer shall have embossed aluminum or stainless steel nameplate indicating, but not restricted to the following:
 - .1 kVA rating.
 - .2 Voltage rating.
 - .3 Impedance.
 - .4 Type.
 - .5 Insulation class.
 - .6 Temperature rise.
 - .7 Connection diagram.
 - .8 Serial number.

2.17 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 53.

2.18 Source Quality Control

- .1 Production test each unit according to NEMA ST-20.

3 Execution

3.01 Installation

- .1 Set transformer plumb and level.
- .2 Use flexible conduit, under the provisions of Section 26 05 33.13, 600 mm minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- .3 Mount wall-mounted transformers using integral flanges or accessory brackets provided by the manufacturer.
- .4 Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- .5 Mount trapeze-mounted transformers as indicated.

- .6 Provide seismic restraints.
- .7 Provide grounding and bonding to Section 26 05 26.
- .8 Mount dry type transformers up to 75 kVA, as indicated.
- .9 Mount dry type transformers above 75 kVA on floor.
- .10 Ensure adequate clearance around transformer for ventilation.
- .11 Install transformers in level upright position.
- .12 Remove shipping supports only after transformer is installed and just before putting into service.
- .13 Loosen isolation pad bolts until no compression is visible.
- .14 Make primary and secondary connections in accordance with wiring diagram.
- .15 Energize transformers after installation is complete.

3.02 Field Quality Control

- .1 Section 01 43 00: Field Inspection, Testing, Adjusting.
- .2 Perform inspections and tests listed in NETA ATS, Section 7.2.

3.03 Adjusting

- .1 Measure primary and secondary voltages and make appropriate tap adjustments.

End of Section

1 General

1.01 Section Includes

- .1 Distribution Switchboards rated 600 volts and less.
- .2 Switchboard accessories.
- .3 Provide design and engineering, labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for distribution switchboards as required for the complete performance of the work, and as shown on the Drawings and as herein specified.

1.02 Related Requirements

- .1 Section 03 30 00 – Cast-in-Place Concrete: Concrete for supporting foundations and pads.
- .2 Section 26 21 16 – Low-Voltage Underground Electrical Service Entrance.
- .3 Section 26 22 13 – Low-Voltage Distribution Transformers.
- .4 Section 26 28 16.02 – Molded Case Circuit Breakers.
- .5 Section 26 24 16 – Panelboards.

1.03 References

- .1 ANSI C39.1 – Requirements for Electrical Analog Indicating Instruments.
- .2 ASTM (ASTM):
 - .1 ASTM E 329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction."
- .3 CSA Group:
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 4-16, Enclosed and dead-front switches.
 - .4 CSA C22.2 No. 5-16, Molded case circuit breakers, molded case switches, and circuit-breaker enclosures.
 - .5 CSA C22.2 No. 144.1-16, Ground-fault circuit interrupters.
 - .6 CSA C22.2 No. 244:19, Switchboards.
 - .7 CSA C22.2 No. 269.2-17, Surge protective devices – Type 2 – Permanently connected.
 - .8 CSA Z462-15, Workplace electrical safety.
 - .9 CSA Z463-18, Maintenance of electrical systems.
- .4 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - .1 ANSI/IEEE C57.13, "Standard Requirements for Instrument Transformers" (copyrighted by IEEE, ANSI approved).
- .5 InterNational Electrical Testing Association (NETA):
 - .1 NETA ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

- .6 International Organization for Standardization (ISO):
 - .1 ISO 9001, Quality Management Systems - Requirements.
- .7 National Electrical Contractors Association (NECA):
 - .1 NECA 400, "Standard for Installing and Maintaining Switchboards" (copyrighted by NECA, ANSI approved).
- .8 National Electrical Manufacturers Association (NEMA):
 - .1 NEMA AB 1 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit - Breaker Enclosures.
 - .2 NEMA C12.1 - Electric Meters; Code for Electricity Metering.
 - .3 NEMA EI 21.1, "Instrument Transformers for Revenue Metering (110 kV BIL and Less)."
 - .4 NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - .5 NEMA PB 2 - Deadfront Distribution Switchboards.
 - .6 NEMA PB 2.1 - Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.
 - .7 NEMA 260 - Safety Labels for Pad Mounted Switchgear and Transformers Sited in Public Areas.
- .9 Ontario Building Code and its referenced standards.
- .10 Underwriters Laboratories, Inc. (UL):
 - .1 UL 1283, "Standard for Safety for Electro-Magnetic Interference Filters" (copyrighted by UL, ANSI approved).

1.04 Pre-installation Meetings

- .1 Conduct preinstallation meeting in accordance with Section 01 31 19.
- .2 Prior to commencing the installation, meet at the Project site to review the material selections, installation procedures, and coordination with other trades. Pre-installation conference shall include, but shall not be limited to, the Contractor, the Installer, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Consultant.

1.05 Action Submittals

- .1 Section 01 33 00: Procedures for submittals.
- .2 Product Data:
 - .1 Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.
 - .2 Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications. Submit product data for each type of switchboard, overcurrent protective device, surge protective device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- .3 Shop Drawings:
 - .1 Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, and ground; and switchboard instrument details.

- .2 Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data. Submit shop drawings for each switchboard and related equipment.
- .3 Indicate front and side enclosure elevations with overall dimensions, conduit entrance locations and requirements, nameplate legends, one-line diagrams, equipment schedule and switchboard instrument details.
- .4 Submit mimic-bus diagram.
- .5 The following information shall be submitted to the Consultant:
 - .1 Master drawing index
 - .2 Front view elevation
 - .3 Floor plan
 - .4 Top view
 - .5 Single line
 - .6 Schematic diagram
 - .7 Nameplate schedule
 - .8 Component list
 - .9 Conduit entry/exit locations
 - .10 Assembly ratings including:
 - .1 Short-circuit rating.
 - .2 Voltage.
 - .3 Continuous current.
 - .11 Major component ratings including:
 - .1 Voltage.
 - .2 Continuous current.
 - .3 Interrupting ratings.
 - .4 Cable terminal sizes.
 - .5 Product data sheets.
 - .12 Where applicable, the following additional information shall be submitted to the Consultant:
 - .1 Busway connection.
 - .2 Connection details between close-coupled assemblies.
 - .3 Composite floor plan of close-coupled assemblies.
 - .4 Key interlock scheme drawing and sequence of operations.

- .6 Wiring Diagrams: Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring, and between components provided by the manufacturer and those provided by others.
- .7 Quality Control Submittals:
 - .1 Test Reports: Submit field quality control test reports.

1.06 Informational Submittals

- .1 Section 01 33 00: Submittals for Information.
- .2 The following submittals are informational; responsive action by the Consultant is not required.
- .3 Test Reports: Indicate results of factory production tests.
- .4 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- .5 The following information shall be submitted for record purposes:
 - .1 Final as-built drawings and information for items listed in paragraph 1.04, and shall incorporate all changes made during the manufacturing process
 - .2 Wiring diagrams
 - .3 Certified production test reports
 - .4 Installation information
 - .5 Seismic certification and equipment anchorage details as specified

1.07 Closeout Submittals

- .1 Section 01 78 00: Submittals for Project Closeout.
- .2 Operation and Maintenance Data:
 - .1 Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
 - .2 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.
- .3 Warranty Documentation: Submit manufacturer's standard warranty documents.
- .4 Record Documentation: Record actual locations of switchboard in project record documents.
- .5 Training session attendance records.

1.08 Maintenance Material Submittals

- .1 To Section 01 78 00.
- .2 Spare Parts: Provide four of each key.

1.09 Quality Assurance

.1 Manufacturer Qualifications:

.1 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

.2 Certifications:

.1 Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

.2 Comply with applicable requirements of the referenced standards.

1.10 Delivery, Storage, and Handling

.1 Section 01 61 00: Transport, Handle, Store, and Protect Products.

.2 Specify shipping split requirements where unusual obstructions, corridor configurations, or door widths will interfere with switchboard handling at site.

.3 Deliver in 1219 mm (48 inch) maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.

.4 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

.5 Handle to NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

.6 Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.

.7 Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

.8 Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

1.11 Warranty

.1 Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for two years from date of substantial performance.

2 Products

2.01 Manufacturers

.1 Manufacturer List:

.1 Square D by Schneider Electric

.2 Eaton (Cutler-Hammer).

.3 Siemens.

.2 Substitutions: Not permitted.

- .3 Product Options: The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 General Switchboard Requirements

- .1 Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated and specified.
- .2 Regulatory Requirements
 - .1 Products certified by CSA Group, or testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.
- .3 Ratings:
 - .1 Voltage: 600 volts.
 - .2 Configuration: Three phase, three wire, grounded.
 - .3 Main Bus: As per Single Line Diagrams.
- .4 Ground Bus: Extend length of switchboard.
- .5 Molded Case Circuit Breakers: To Section 26 28 16.02 – Molded Case Circuit Breakers.
- .6 Ground fault trip, zero sequence type ground fault sensor.
 - .1 Instantaneous trip.
 - .2 Adjustable short time trip.
 - .3 Stationary mounting or drawout construction, as applicable.
 - .4 Include shunt trip where indicated.
- .7 Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials and sizes indicated.
- .8 Ground Fault Sensor: Zero sequence type.
- .9 Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.
- .10 Ground Fault Sensor: Zero sequence type.
- .11 Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.
- .12 Incoming entry: As noted on plans.
- .13 Incoming location: As noted on plans.
- .14 Branch Circuit Entry: Top.
- .15 Silver Flashed Copper.
- .16 Minimum Interrupt Rating: 65 kA.
- .17 Bus Bracing Rating: 65 kA.

- .18 Solid Bottom Plates.
- .19 Box Finish - ASA 61 (Std).
- .20 Trim Finish - ASA 61 (Std).
- .21 Silver Flashed Copper Ground Bus.
- .22 Vermin proof.
- .23 Channel Sills.
- .24 Refer to Single Line Diagram for additional information.

2.03 Short Circuit Ratings

- .1 The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current 65 000 amperes symmetrical at rated voltage or as indicated on the drawings.
- .2 Use fully rated overcurrent devices. Series ratings will not be accepted.

2.04 Construction

- .1 The entire assembly shall be front accessible and shall consist of main lugs or main device as shown on the plans.
- .2 Feeder devices 150 ampere frame through 1200 ampere frame shall be panel-mounted-type construction. Devices over 1200 ampere frame or main devices shall be individually mounted when required.

2.05 Bus

- .1 All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).
- .2 A copper ground bus (minimum 1/4 inch by 2 inch), shall be furnished firmly secured to each vertical section structure, and shall extend the entire length of the switchboard.
- .3 Copper neutral bus.
- .4 All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

2.06 Wiring/Termination

- .1 Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- .2 Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 90 degrees C of the size as indicated on the drawings.
- .3 Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.
- .4 All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle-type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.07 Enclosure

- .1 Provide CSA type 2 steel enclosure complete with sprinklerproof drip shield.
- .2 Align sections at front and rear.
- .3 Switchboard Height: 2286 mm (90 inches), excluding floor sills, lifting members and pull boxes.
- .4 Section depths: as per drawings.
- .5 Section widths: as per drawings.

2.08 Enclosure Finish

- .1 All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a factory applied rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.
- .2 Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

2.09 Barriers

- .1 Provide barriers between adjacent switchboard sections.

2.10 Insulation and Isolation

- .1 Provide taped bus for through bus.

2.11 Front Covers

- .1 Front covers shall be screw removable with a single tool and doors shall be hinged with removable hinge pins.

2.12 Bus Transition and Incoming Pull Sections

- .1 Match and align with basic switchboard.

2.13 Pull Box on Top of Switchboard

- .1 Provide adequate ventilation to maintain temperature in pull box within same limits as switchboard.
- .2 Set back from front to clear circuit breaker removal mechanism.
- .3 Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
- .4 Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
- .5 Lace cables using industry-approved methods.

2.14 Feeder Entry

- .1 Coordinate busway or cable feeder entry requirements with Single Line Diagram.
- .2 Provide busway flange to suit busway feeders.

2.15 Future Devices

- .1 Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit breaker compartment.
- .2 Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.

2.16 Metering and Instrumentation

- .1 Utility Metering Compartment: Provide fabricated compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.
- .2 Instrumentation for Owner's metering:
 - .1 Instrument Transformers: NEMA EI 21.1, ANSI/IEEE C57.13, and the following:
 - .1 Potential Transformers: Secondary voltage rating of 120 volts and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 - .2 Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
 - .3 Control Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.
 - .2 Multifunction Digital Metering Monitor: Microprocessor-based unit suitable for three-wire or four-wire systems and with the following features:
 - .1 Digital Display: Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - .2 Phase Currents, Each Phase: ± 1 percent.
 - .3 Phase-to-Phase Voltages, Three-Phase: ± 1 percent.
 - .4 Phase-to-Neutral Voltages, Three-Phase: ± 1 percent.
 - .5 Megawatts: ± 2 percent.
 - .6 Megavars: ± 2 percent.
 - .7 Power Factor: ± 2 percent.
 - .8 Frequency: ± 0.5 percent.
 - .9 Megawatt Demand: ± 2 percent; demand interval programmable from 5 to 60 minutes.
 - .10 Accumulated Energy, Megawatt Hours: ± 2 percent. Accumulated values unaffected by power outages up to 72 hours.
 - .11 Watt-Hour Meters: Flush or semi-flush type, rated 5 amperes, 120 volts, three-phase, three-wire, with three elements, 15 minute-indicating-demand register, and provision for testing and adding pulse initiation.
 - .12 Recording Demand Meter: Usable as totalizing relay or as indicating and recording maximum demand meter with 15 minute interval. Meter shall count and control a succession of pulses entering two channels.
 - .13 Mounting: Display and control unit flush or semi-flush mounted in instrument compartment or main device door.
 - .3 Interface with other systems: Provide BACnet gateway for connection to Building Automation per Section 25 95 00.

2.17 Mimic Bus

- .1 Provide an anodized aluminum or plastic engraved plaque. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic bus diagram. Produce a concise visual presentation of principal switchboard components and connections.

- 2 Show bussing, connections and devices in single line form on the front panels of the switchboard using blue colour light metal strips, fastened flat against the panel face with screws or rivets.

2.18 Nameplates

- .1 Lamacoid nameplates to Section 26 05 53:
 - .1 Switchboard nameplate.
 - .2 Branch circuit nameplates.
- .2 Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

2.19 Ground Fault Protection

- .1 Furnish and install in the service equipment and/or switchboard ground fault protection and indication equipment as shown on drawings in accordance with 2018 OESC 14-102. All parts of the systems specified shall be CSA certified. All new ground fault protection and indication equipment shall be factory installed, wired, and tested by the switchboard manufacturer.

2.20 Source Quality Control

- .1 Section 01 43 00: Manufacturer quality control.
- .2 Shop inspect and test switchboard according to NEMA PB 2.
- .3 Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Engineer at least 7 days before inspections and tests are scheduled.
- .4 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 - .1 The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground.
 - .2 Perform factory and installation tests in accordance with applicable OESC, NEMA and CSA requirements.
- .5 The manufacturer shall provide three (3) certified copies of factory test reports.
- .6 A certified test report of all standard production tests shall be available to the Consultant upon request.

3 Execution

3.01 Examination

- .1 Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Consultant, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- .2 Verify that field measurements are as indicated on shop drawings.
- .3 Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.02 Preparation

- .1 Provide concrete housekeeping pad to Section 03 30 00.

3.03 Installation

.1 General

- .1 Preparation and installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings.
- .2 Install switchboards and accessories according to NEMA PB 2.1 and NECA 400.
- .3 Install and anchor switchboards level on concrete bases, 4 inch (102 mm) nominal thickness. Concrete base is specified in Section 26 05 00, and concrete materials and installation requirements are specified in Division 03 - Concrete.
- .4 Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- .5 Frame and mount the printed basic operating instructions for switchboards, including, but not limited to, control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- .6 Install overcurrent protective devices, surge protective devices, and instrumentation.
 - .1 Set field-adjustable switches and circuit breaker trip ranges.
- .7 Install spare fuse cabinet.
- .2 Install switchboard in locations shown on drawings, according to CSA C22.1.
- .3 Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- .4 Install fuses in each switch.
- .5 Install all equipment per the manufacturer's recommendations and the contract drawings.
- .6 The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to Contractor supplied floor sills to be set level in concrete per manufacturer's recommendations the floor without the use of floor sills providing the floor is level to 1/8 inch per 3 foot distance in any direction. All necessary hardware to secure the assembly in place shall be provided by the Contractor.
- .7 Examine substrates and conditions in which units will be installed. Check for clearance that will be required before, during and after equipment installation. Do not proceed with installation until unsatisfactory conditions are corrected.
- .8 Strictly comply with manufacturer's instructions and recommendations and NEMA PB 2.1. Coordinate installation with adjacent work to ensure proper sequence of construction, clearances and support.
- .9 Install units plumb, level, and rigid without distortion to the switchboard cubicle(s).
- .10 Identification
 - .1 Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 53.
 - .2 Label each switchboard compartment with engraved metal or laminated plastic nameplate mounted with corrosion-resistant screws.

- .3 Arc Flash Warning Labels
 - .1 Refer to Section 26 05 73.19.
 - .2 Apply in the field, the arc flash warning label to all switchboards to suit future examination, adjustment, servicing, or maintenance while energized to warn qualified persons of potential electrical arc flash hazards.

3.04 Field Quality Control

- .1 Section 01 43 00: Quality Assurance.
- .2 Perform inspections and tests listed in NETA ATS, Section 7.1.
- .3 Prepare for acceptance tests as follows:
 - .1 Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - .2 Test continuity of each circuit.
- .4 Perform the following field tests and inspections and prepare test reports:
 - .1 Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
 - .2 Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.05 Protection

- .1 Provide final protection and maintain conditions in a manner that shall ensure that the switchboards shall be without damage at time of Substantial Performance.

3.06 Adjusting

- .1 Section 01 78 00: adjusting installed work.
- .2 Adjust all operating mechanisms for free mechanical movement.
- .3 Tighten bolted bus connections to manufacturer's instructions.
- .4 Adjust circuit breaker trip and time delay settings to values indicated as instructed by Consultant.
- .5 Coordination Study Labels and Field Adjustment
 - .1 Refer to Section 26 05 73.16.
 - .2 The Contractors shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.
 - .3 Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish conformance with an approved short-circuit and protective device coordination study, shall be carried out by the Contractor at no additional cost to the Owner.

3.07 Cleaning

- .1 Section 01 74 00: cleaning installed work.
- .2 Clean exposed surfaces using manufacturer recommended materials and methods.

- .3 Touch-up damaged coatings and finishes using non-abrasive materials and methods recommended by manufacturer. Eliminate all visible evidence of repair.
- .4 Touch up scratched or marred surfaces to match original finish.

3.08 Training

- .1 The Contractor shall provide a training session for up to five (5) Owner's representatives for normal workdays at a jobsite location determined by the Owner.
- .2 A manufacturer's qualified representative shall conduct the training session. The training program shall consist of instruction on the operation of the assembly, circuit breakers, fused switches, meters, and major components within the assembly.

End of Section

1 General

1.01 Section Includes

- .1 Power distribution panelboards – Circuit breaker type.
- .2 Lighting and Appliance Branch Circuit Panelboards.

1.02 Related Requirements

- .1 Section 26 28 16.02 – Molded Case Circuit Breakers.
- .2 Section 26 43 13 – Surge Protective Devices for Low-Voltage Electrical Power Circuits.

1.03 References

- .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (27th edition/2018).
- .3 CSA C22.2 No.29 - Panelboards and Enclosed Panelboards.
- .4 NEMA AB1 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit - Breaker Enclosures.
- .5 NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
- .6 NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- .7 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).
- .8 The panelboards and circuit breakers referenced herein are designed and manufactured according to the latest revision of the following specifications.
 - .1 NEMA PB 1 - Panelboards
 - .2 NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
 - .3 NEMA AB 1 - Molded Case Circuit Breakers
 - .4 CSA C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
 - .5 CSA C22.2 No. 5-M91 - Molded Case Circuit Breakers

1.04 Submittals

- .1 Submit in accordance with Section 01 33 00.
- .2 Shop drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.
- .3 Shop drawings
 - .1 Indicate the following:
 - .1 Outline and support point dimensions
 - .2 Voltage

- .3 Main bus ampacity
- .4 Integrated short circuit ampere rating
- .5 Circuit breaker arrangement, types and sizes.
- .2 The following information shall be submitted to the Engineer:
 - .1 Breaker layout drawing with dimensions indicated and nameplate designation
 - .2 Component list
 - .3 Conduit entry/exit locations
 - .4 Assembly ratings including:
 - .1 Short-circuit rating
 - .2 Voltage
 - .3 Continuous current
 - .5 Cable terminal sizes
 - .6 Product data sheets
- .3 Where applicable, the following additional information shall be submitted to the Engineer:
 - .1 Key interlock scheme drawing and sequence of operations
- .4 Submittals for Construction
 - .1 The following information shall be submitted for record purposes:
 - .1 Installation information

1.05 Closeout Submittals

- .1 Refer to Section 01 78 00.
- .2 Record actual locations of panelboards and record actual circuiting arrangements in project record documents.
- .3 Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
- .4 Final as-built drawings and information shall incorporate all changes made during the manufacturing and installation process.
- .5 Include a copy of each panelboard schedule in the Operation and Maintenance manual.

1.06 Maintenance Material Submittals

- .1 Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- .2 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.
- .3 Provide two of each panelboard key.
- .4 Provide final panelboard schedules indicating panelboard data, phasing, breaker sizes, and loads served.

1.07 Quality Assurance

- .1 Regulatory Requirements
 - .1 Products: Listed and classified by CSA (Canadian Standards Association).
- .2 Qualifications
 - .1 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

1.08 Delivery, Storage, and Handling

- .1 Inspect and report concealed damage to carrier within their required time period.
- .2 Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
- .3 Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.
- .4 Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

1.09 Manufacturer Warranty

- .1 Warrant specified equipment to be free from defects in materials and workmanship for two (2) years from the date of substantial performance.

2 Products

2.01 General

- .1 Description: CSA C22.2 No.29, circuit breaker type.

2.02 Distribution Panelboards – Circuit Breaker Type

- .1 Manufacturers:
 - .1 Square D by Schneider Electric, I-LINE Series.
 - .2 Eaton Cutler-Hammer, PRL 3 and PRL4 Series.
 - .3 Equal by Siemens.
- .2 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten days prior to bid date.
- .3 Panelboard Bus:
 - .1 Copper, ratings as indicated.
 - .2 Provide copper neutral bus for panelboards indicated for 4-wire systems.
 - .3 Provide copper ground bus in each panelboard.
- .4 Short Circuit Ratings:

- .1 Panelboards rated 600 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 65 000 amperes RMS symmetrical.
- .2 Distribution panelboards with bolt-on devices contained therein shall have interrupting ratings as specified herein or indicated on the drawings.
- .3 Panelboards shall be fully rated.
- .4 Where indicated, provide circuit breakers ULC listed for application at 100 per cent of their continuous ampere rating in their intended enclosure.
- .5 Minimum integrated short circuit rating: Panelboards rated 240 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10 000 amperes RMS symmetrical.
- .6 Molded Case Circuit Breakers: To Section 26 28 16.02.
- .7 Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- .8 Cabinet Front: Surface type, fastened hinge and latch, metal directory frame, finished in manufacturer's standard gray enamel.
- .9 Enclosures: CSA type 2 sprinklerproof complete with drip hood, or as noted.
- .10 Trims shall be equipped with a flush lock.
- .11 Breaker positions labeled as "Spare" or "Space" shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.
- .12 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.

2.03 Branch Circuit Panelboards

- .1 Manufacturers:
 - .1 Square D by Schneider Electric, NQ or NQOD Series.
 - .2 Eaton Cutler-Hammer, POW-R-LINE 1, POW-R-LINE 2, POW-R-LINE 3 Series.
 - .3 Equal by Siemens.
- .2 Description: CSA C22.2 No.29, circuit breaker type, lighting and appliance branch circuit panelboard.
- .3 Panelboard Bus:
 - .1 Copper, ratings as indicated.
 - .2 Provide copper neutral bus in each panelboard.
 - .3 Provide copper ground bus in each panelboard.
 - .4 Provide insulated ground bus where scheduled.
- .4 Minimum Integrated Short Circuit Rating: 10 000 amperes RMS symmetrical for 240 volt panelboards, or as indicated.
- .5 Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

- .6 Current Limiting Molded Case Circuit Breakers where indicated: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
- .7 Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- .8 Enclosure shall be CSA type 2 sprinklerproof complete with drip hood, or as noted.
- .9 Trims shall be equipped with a flush lock
- .10 Breaker positions labeled as "Spare" or "Space" shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.
- .11 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .12 Panelboards rated 240 Vac or less shall have short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.
- .13 Bus and breakers rated for symmetrical interrupting capacity, as indicated.
- .14 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .15 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .16 Two keys for each panelboard and key panelboards alike.
- .17 Copper bus with neutral of same ampere rating as mains.
- .18 Mains: suitable for bolt-on breakers.
- .19 Trim with concealed front bolts and hinges.
- .20 Trim and door finish: baked grey enamel.
- .21 The minimum short-circuit rating for branch circuit panelboards shall be as specified herein or as indicated on the drawings. Panelboards shall be fully rated.
- .22 Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.
- .23 Circuit breakers shall be thermal-magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame and through 100-ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be ULC listed as type SWD for lighting circuits.
 - .1 Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.
- .24 Circuit breakers shall have a minimum interrupting rating of 10 000 amperes symmetrical at 240 volts, and 14 000 amperes symmetrical at 480 volts, unless otherwise noted on the drawings.

- .25 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.
- .26 Lighting and receptacle panels shall be surface or flush-mounting type, as shown.
- .27 Panels shall be dead front type in code gauge steel enclosures. All panels shall be sprinkler proof c/w drip hoods as required.
- .28 Panels shall have mains of voltage and capacity, and main and branch breakers, as shown on the drawings. Spaces shall include necessary bus work such that Owners, at a later date, need buy only the breakers.
- .29 Where panels exceed 42 circuits, use multi-section panel with main cross-over solid bus bars. Main bus capacity of each section shall be full size to match cross-over bus.
- .30 Breakers shall have bolted type connections. Multi-pole breakers shall be common trip type with a single handle, suitable for voltage applied and of same manufacture as single pole breakers.
- .31 Panels for 120/208 volt, 3-phase, 4-wire systems shall be complete with full size breakers.
- .32 Where shown on drawings or required by code, certain breakers shall include ground fault interrupter.
- .33 Provide lighting and receptacle panels, surface or flush-mounting type, as shown.
- .34 Provide locking bars on non-switched circuits where panels are used for switching lighting circuits.
- .35 Panels for non-linear loads shall be complete with lugs for double neutrals.
- .36 Panels shall be given a rust-resistant treatment to both tub and trim.
- .37 Flush panels shall have concealed hinges and flush type combination lock latch. Locks shall be chrome plated. Doors shall open minimum 135 degrees. Trims shall have fasteners concealed and shall be prime coated to receive room finish paint.
- .38 Surface mounted panels shall have manufacturer's standard surface door trim complete with lock and latch. Finish shall be grey.
- .39 Recessed panels shall have standard flush trims.
- .40 Co-ordinate panel finish with Room Finish Schedule.

2.04 Molded Case Circuit Breakers

- .1 Breakers: to Section 26 28 16.02.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10 per cent of 15 A to 30 A breakers installed as indicated. Turn over unused lock-on devices to Owner.
- .5 Lock-on devices for fire alarm, security, and sprinkler circuits.
- .6 Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.
- .7 Provide breakers for externally mounted Surge Protective Devices in accordance with Section 26 43 13.

2.05 Construction

- .1 General:

- .1 Interiors shall be completely factory assembled. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
- .2 Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.
- .3 A temporary directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.
- .4 All locks shall be keyed alike. Key same as existing.

.2 Branch Circuit Panelboards:

- .1 Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Door-in-door trim shall be provided. Both hinged trim and trim door shall utilize three point latching. No tools shall be required to install or remove trim. Trim shall be equipped with a door-actuated trim locking tab. Equip locking tab with provision for a screw such that removal of trim requires a tool, at the owner's option. Installation shall be tamper resistant with no exposed hardware on the panelboard trim.

.3 Distribution Panelboards:

- .1 Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.

2.06 Bus

- .1 Main bus bars shall be copper sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.
- .2 A copper system ground bus shall be included in all panelboards.
- .3 Full-size (100 per cent rated) insulated copper neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200 per cent rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.

2.07 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 53.
- .2 Nameplate for each panelboard size 4 engraved.
- .3 Nameplate for each branch circuit in distribution panelboards size 2 engraved.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.
- .5 Provide an engraved nameplate for each panelboard section.
- .6 Provide copies of all circuit directories in Manuals.

2.08 Source Quality Control

- .1 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and CSA standards.

3 Execution

3.01 Installation

- .1 Install panelboards to CSA C22.1.

- .2 Install panelboards plumb.
- .3 Height: 1800 mm to top of panelboard; install panelboards taller than 1800 mm with bottom no more than 100 mm above floor.
- .4 Provide filler plates for unused spaces in panelboards.
- .5 Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- .6 Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- .7 Ground and bond panelboard enclosure according to Section 26 05 26.
- .8 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .9 Install surface mounted panelboards on fire rated plywood backboards in accordance with Section 06 10 00. Where practical, group panelboards on common backboard.
- .10 Connect loads to circuits.
- .11 Connect neutral conductors to common neutral bus with respective neutral identified.
- .12 Deliver five (5) duplicate keys for each panel lock to Owner.
- .13 Mount electrical panels, where possible, with top of trim at uniform height of 2000 mm.
- .14 Cap ends of conduits in accessible locations in ceiling spaces above panels, to allow for future wiring.
- .15 The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- .16 Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and Electrical Code requirements.
- .17 After completion of wiring, type directory showing a clear description of each circuit being controlled from panel and place in metal frame inside door.
- .18 Provide revised directories for existing panels if revised.
- .19 Provide circuit breaker handle locks for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.
- .20 [Provide three 27 mm empty conduits from top of lighting, receptacle, telephone, signal and communication panels recessed in walls, to ceiling space.]

3.02 Field Quality Control

- .1 Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.
- .2 Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- .3 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20 per cent of each other. Maintain proper phasing for multi-wire branch circuits.
- .4 Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.03 Adjusting

- .1 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other.

- .2 Maintain proper phasing for multi-wire branch circuits.

End of Section

1 General

1.01 Section Includes

- .1 Switches, receptacles, wiring devices, cover plates and their installation.

1.02 Related Requirements

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 27 26.13 – Floor Box Assemblies.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 14-13, Industrial control equipment
 - .4 CSA C22.2 No. 42-10 (R2015), General use receptacles, attachment plugs, and similar devices.
 - .5 CSA C22.2 No. 42.1-13, Cover plates for flush-mounted wiring devices.
 - .6 CSA C22.2 No. 55-15 (R2020), Special use switches.
 - .7 CSA C22.2 No.111-10 (R2015), General-use snap switches.
 - .8 CSA C22.2 No. 182.1-17, Plugs, receptacles, and cable connectors of the pin and sleeve type

1.04 Informational Submittals

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.
- .3 Submit manufacturer's installation instructions.

2 Products

2.01 Manufacturers

- .1 Eaton.
- .2 Hubbell Bryant.
- .3 Leviton.
- .4 Molex.
- .5 Pass & Seymour (Legrand).

2.02 Wall Switches

- .1 Single pole, double pole, three-way, four-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Description: CSA-C22.2 No.111, Commercial Spec Grade, AC only general-use snap switch.

- .3 Local switches shall be 20 ampere, silent, brown coloured, AC type and CSA certified, specification grade. Provide switches rated to suit system voltage 120 V or 347 V.
- .4 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
- .5 Voltage: 120 volt or 347 volt, AC as indicated.
- .6 Current: 20 amperes.
- .7 Body and Handle: white plastic with toggle handle. Confirm finish colour prior to ordering.
- .8 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .9 Example Products (Decorator style):
 - .1 120 volt:
 - .1 Hubbell HBL2121 series.
 - .2 347 volt:
 - .1 Pass & Seymour 2601-347 series.
- .10 Example Products (Toggle style):
 - .1 120 volt:
 - .1 Hubbell HBL1221 (single pole).
 - .2 Hubbell HBL1222 (double pole).
 - .3 Hubbell HBL1223 (three-way).
 - .4 Hubbell HBL1224 (four-way).
 - .2 347 volt:
 - .1 Hubbell HBL18221 (single pole).
 - .2 Hubbell HBL18223 (three-way).
 - .3 Pass & Seymour PS372030I.
- .11 Local switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.

2.03 Receptacles

- .1 General
 - .1 Description: CSA C22.2 No.42, Commercial Spec Grade general use receptacles.

- .2 Device Body: white plastic.
- .3 Configuration: Type as specified and indicated.
- .4 Convenience Receptacle: Type 5-15, 5-20 where indicated.
- .5 GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
- .6 Data Room Receptacle Types: As indicated on drawings.
- .7 Receptacles of one manufacturer throughout project.
- .2 Receptacles shall be white coloured, specification grade, unless noted otherwise.
- .3 Receptacles shall be as listed below:
 - .1 15 ampere, 120 volt, single phase grounded duplex receptacle shall be NEMA-U- ground type CSA Configuration 5-15R.
 - .2 20 ampere, 120 volt, single phase grounded duplex receptacle shall be NEMA-U-ground type CSA Configuration 5-20RA
 - .3 15 ampere, 120 volt, weatherproof receptacles shall be equal to those above but complete with gasketed cast plate and hinged covers.
- .4 Other types of receptacles shall be provided as shown on Drawings.
- .5 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
- .6 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .7 Other receptacles with ampacity and voltage as indicated.
- .8 Example Products (Decorator style duplex 5-15R):
 - .1 Pass & Seymour 26252 Series.
 - .2 Hubbell HBL2152 Series.
- .9 Ground Fault Circuit Interrupter (GFCI or GFI) Receptacles
 - .1 Protected by a ground fault circuit interrupter of the Class A type.
 - .2 Any receptacle within 1.5 m of a sink must be GFCI protected.

- .3 Any receptacle located outdoor must be GFCI protected.
- .10 Isolated Ground (IG) Receptacles:
 - .1 Marked as such (green triangle).
 - .2 Example Products:
 - .1 Hubbell IG2152 (15A duplex decorator style, orange faceplate).
- .11 Tamper-resistant receptacles.
 - .1 Marked as such (for example “TR”).
 - .2 To be used in the following spaces:
 - .1 Child care facilities and kindergarten classrooms.
 - .2 Guest rooms and suites of hotels and motels.
 - .3 Preschools and elementary education facilities, including kindergarten facilities.
 - .4 Dwelling units.
 - .3 Example Products:
 - .1 Hubbell BR15WHITR (15A duplex decorator style).
 - .2 Hubbell BR20WHITR (20A duplex decorator style).
- .12 Wet location and weatherproof devices:
 - .1 Receptacles and cover plates suitable for wet locations, cover plates to provide shielding with and without a plug inserted into the receptacle in accordance with OESC rule 26-702. Cover plates to be marked “Extra Duty”.
 - .2 Receptacles shall be 20 A rated, GFI.

2.04 Cover Plates

- .1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Stainless steel, vertically brushed, cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .5 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.
- .8 Decorative Cover Plate: Polycarbonate.
 - .1 Pass & Seymour TP26W series.
- .9 Switch, receptacle, telephone and other plates shall be stainless steel 18-8 chrome metal alloy, Type 302, non-metallic in finished areas and pressed steel in unfinished areas. Finish brush marks shall be run in a vertical direction.

- .10 Wet Location and weatherproof devices: receptacles and cover plates shall be suitable for wet locations, and provide shielding with and without a plug inserted into the receptacle in accordance with 2018 OESC rule 26-710.

2.05 Pendant Receptacles

- .1 Pendant cord mounted single receptacles complete with strain relief device.
- .2 Strain relief system: Hubbell Kellems Grips, Molex, or equal.

2.06 Receptacle Cord Reels

- .1 Retractable cable reel, mounted to structure above. 125 V, 5-15R [5-20R] C/W [25] [40] feet of cable (or equal).
- .2 Provide framing bracket to support reel at underside of structure above.
- .3 Connect to GFCI breakers.
- .4 Manufacturers:
 - .1 Hubbell HBL-C40-123TT.
 - .2 Woodhead (Molex) 997 series.
 - .3 Approved equal.

2.07 Special Wiring Devices

- .1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel flush type.

2.08 Pin and Sleeve Devices

- .1 Manufacturers:
 - .1 Crouse-Hinds by Eaton.
 - .2 Hubbell.
 - .3 Meltric.
 - .4 Mennekes.
 - .5 Russellstoll (Thomas & Betts).
 - .6 Walther Electric.
- .2 Refer to equipment schedule and plans for locations and specific requirements.

2.09 Regulatory Requirements

- .1 Provide products listed and classified by CSA (Canadian Standards Association).

3 Execution

3.01 Examination

- .1 Verify that outlet boxes are installed at proper height.
- .2 Verify that wall openings are neatly cut and will be completely covered by wall plates.

- .3 Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 Preparation

- .1 Provide extension rings to bring outlet boxes flush with finished surface.
- .2 Clean debris from outlet boxes.

3.03 Installation

- .1 Install to CSA C22.1.
- .2 Mounting heights in accordance with Section 26 05 00.
- .3 Install devices plumb and level.
- .4 Install switches with OFF position down.
- .5 Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.
- .6 Do not share neutral conductor on load side of dimmers.
- .7 Install receptacles with grounding pole on bottom.
- .8 Connect wiring device grounding terminal to outlet box with bonding jumper.
- .9 Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- .10 Connect wiring devices by wrapping conductor around screw terminal.
- .11 Use jumbo size plates for outlets installed in masonry walls.
- .12 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- .13 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .14 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .3 Connect receptacle grounding terminal to the outlet box with an insulated green ground strap.
 - .4 [Provide a combination-type arc-fault circuit interrupter on all dwelling unit branch circuit breakers supplying 125 V receptacles rated 20 A or less except for receptacles serving kitchen counters, refrigerators, bathrooms, or sump pumps in accordance with OESC requirements.]
 - .5 Receptacles for maintenance of HVAC and similar equipment located on rooftops.
 - .1 Provide weatherproof GFI 5-20R receptacles on roof, installed at 750 mm (30 inches) above finished roof level, complete with wet location cover plate.
 - .2 Locate within 7500 mm (25 feet) of new HVAC equipment, and at least 1800 mm (6 feet) away from roof line.

.3 Refer to 2018 OESC rules 2-316, 26-708, and 26-710, and OESC bulletin 26-27-0, or latest edition.

.15 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Do not install plates until final painting of room or area is completed. Remove protective covering.

.16 Circuit identification: in accordance with Section 26 05 53.

3.04 Field Quality Control

.1 Inspect each wiring device for defects.

.2 Operate each wall switch with circuit energized and verify proper operation.

.3 Verify that each receptacle device is energized.

.4 Test each receptacle device for proper polarity.

.5 Test each GFCI receptacle device for proper operation.

3.05 Adjusting

.1 Adjust devices and wall plates to be flush and level.

3.06 Cleaning

.1 Clean exposed surfaces to remove splatters and restore finish.

End of Section

1 General

1.01 Summary

- .1 Section Includes
 - .1 In-slab and poke-through style floor monuments for electrical, communications, and audio/video purposes.
- .2 Related Requirements
 - .1 Section 03 80 00 – Concrete Cutting and Boring.
 - .2 Section 26 27 26 – Wiring Devices.
 - .3 Section 27 15 13 – Communications Copper Horizontal Cabling.

1.02 Reference Standards

- .1 Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:
 - .1 U.L Standard #514

1.03 Submittals

- .1 Submit manufacture's catalog cuts and specifications for all floor boxes, and accessories.

2 Products

2.01 Manufacturers

- .1 Canadian Electric Raceways.
- .2 Hubbell.
- .3 Wiremold.
- .4 Wellmark.
- .5 Steel City.

2.02 Floor Monuments, General

- .1 Power: two duplex 5-20R receptacles.
- .2 Data: up to four voice/data drops.
- .3 Audio/Video:
 - .1 VGA
 - .2 PC Audio.
- .4 Power and Low Voltage Divider.
- .5 Monument lid should be flush with finished floor, and be able to accept a cut-to-fit carpet or vinyl tile.

2.03 Floor Boxes

- .1 Floor Boxes: CSA C22.2 No. 18, fully adjustable, 38 mm deep.
- .2 Material: Cast metal.
- .3 Shape: Rectangular.
- .4 Service Fittings: As specified in Section 26 27 26.
- .5 Cast aluminum boxes for devices installed below raised floor or on side of overhead cable tray for computer room

3 Execution

3.01 Installation

- .1 Electrical contractor to verify the thickness of the floor and select the through floor component that fits floor thickness.
- .2 Install so that cover plates are flush with top of finished floor.
- .3 The electrical documents shall not be used for the purpose of establishing locations of floor outlets. The location of such outlets shall be established by the Architect.

End of Section

1 General

1.01 Submittals

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide fuse performance data characteristics for each fuse type and size above 200 amps. Performance data to include: average melting time-current characteristics.
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00.

1.02 Delivery, Storage, and Handling

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in storage cabinet.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19.

1.03 Maintenance Material Submittals

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 3 spare fuses of each type and size installed above 600 A.
- .3 6 spare fuses of each type and size installed up to and including 600 A.

2 Products

2.01 Manufacturers

- .1 Bussman by Eaton.
- .2 GEC.
- .3 Littelfuse.
- .4 Mersen.
- .5 Substitutions: not permitted.

2.02 Fuses - General

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.
- .3 Fuses shall be sized as shown, time delay type, and of the same type throughout.
- .4 Fuses shall be CSA certified Class-J for 1-600A or Class-L for 650 Amps and above.

2.03 Fuse Types

- .1 Class J fuses.
 - .1 Type J1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.
 - .2 Type J2, fast acting.
- .2 Class L fuses.
 - .1 Type L1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.
 - .2 Type L2, fast acting.
- .3 Class R fuses.
 - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum, to meet UL Class RK1 maximum let-through limits.
 - .2 Type R2, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.
 - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

2.04 Fuse Requirements

- .1 Dimensions and Performance: CSA C22.2 No. 248 Series, Class as specified or indicated.
- .2 Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- .3 Power Load Feeder Switches: HRC-1 Class J time delay type.
- .4 Other Feeder Switches: HRC-1 Class J time delay type.

2.05 Spare Fuse Cabinet

- .1 Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified.
- .2 Doors: Hinged, with hasp for Owner's padlock.
- .3 Finish: Prime finish for field painting.
- .4 Dimensions: Minimum 3 foot by 3 foot by 1 foot.

3 Execution

3.01 Installation

- .1 Install fuses to manufacturer's instructions.
- .2 Install fuse with label oriented such that manufacturer, type, and size are easily read.
- .3 Install spare fuse cabinet in electrical room.
- .4 Provide a complete set of fuses in each fusible device supplied under this Division and provide 3 spare fuses for each size used in spare fuse cabinet.

End of Section

1 General

1.01 Section Includes

- .1 Materials for Molded-Case Circuit Breakers (MCCB).
- .2 Accessories

1.02 Related Requirements

- .1 Section 26 24 13 – Switchboards.
- .2 Section 26 24 16 – Panelboards.

1.03 References

- .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (27th edition/2018).
- .3 CSA-C22.2 No. 5-02, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).
- .4 NEMA AB1 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit - Breaker Enclosures.
- .5 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.04 Submittals

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Include time-current characteristic curves for breakers with ampacity of 400 A and above, or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- .3 Include termination temperature rating in degrees C.
- .4 Certificate of Origin
 - .1 Prior to any installation of circuit breakers in either a new or existing installation, Contractor must submit three (3) copies of a certificate of origin from the manufacturer, duly signed by the factory and the local manufacturer's representative, certifying that all circuit breakers come from this manufacturer, they are new and they meet standards and regulations. These certificates must be submitted to the Engineer for approval.
 - .2 A delay in the production of the certificate of origin won't justify any extension of the contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation should begin only after acceptance of the certificate of origin by Engineer. Unless complying with this requirement, Engineer reserves the right to mandate the manufacturer listed on circuit breakers to authenticate all new circuit breakers under the contract, and that, to Contractor's expense.
 - .4 In general, the certificate of origin must contain:
 - .1 The name and address of the manufacturer, and the person responsible for authentication. The responsible person must sign and date the certificate;
 - .2 The name and address of the licensed dealer, and the person of the distributor responsible for the Contractor's account.

- .3 The name and address of the Contractor, and the person responsible for the project.
- .4 The name and address of the local manufacturer's representative. The local representative must sign and date the certificate.
- .5 The name and address of the building where circuit breakers will be installed:
 - .1 Project title
 - .2 End user's reference number
 - .3 The list of circuit breakers

2 Products

2.01 General

- .1 Molded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters, Fused circuit breakers, and Accessory high-fault protectors: to CSA C22.2 No. 5
- .2 Bolt-on Molded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Plug-in Molded case circuit breakers: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .4 Common-trip breakers: with single handle for multi-pole applications.
- .5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .6 Circuit breakers with interchangeable trips.

2.02 Interrupting Capacity

- .1 Protective devices shall be fully rated, for required available fault current. Series rated shall not be used on this installation.
- .2 Refer to panelboard and switchboard Specification Sections.

2.03 Molded Case Circuit Breakers – General

- .1 Molded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .2 NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
- .3 Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- .4 1-, 2-, or 3-pole bolt on, single-handle common trip voltage as indicated on drawings.
- .5 Overcentre toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
- .6 Calibrate for operation in 40 degree C ambient temperature.

2.04 Molded Case Circuit Breakers – Up to 150 Ampere

- .1 Permanent trip unit containing individual thermal and magnetic trip elements in each pole, unless noted otherwise on drawings.

2.05 Molded Case Circuit Breakers – 151 to 399 Ampere

- .1 Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.

2.06 Molded Case Circuit Breakers – 400 Ampere and Above

- .1 Electronic trip type with adjustments for long-time, instantaneous and short-time functions.

- .2 Provide ground fault function for breakers greater than 400 Amps.

- .3 1000 Amp and Above:

- .1 Modbus Communications

- .1 Breaker status.

- .1 Open.

- .2 Closed.

- .3 Tripped.

- .2 Cause of trip.

- .3 Time of trip.

- .4 Current at time of trip.

- .5 RMS currents per phase and ground.

- .6 Peak demand.

- .7 Present demand.

- .8 Energy consumption.

- .4 1200 Amp and Above:

- .1 Provide handle mechanisms that are lockable in the open (off) position.

2.07 Additional Features

- .1 Provide as indicated on drawings:

- .1 Shunt trip

- .2 Auxiliary switch

- .3 Motor-operated mechanism.

- .4 Under-voltage release

- .5 On-off locking device

- .6 Handle mechanism

3 Execution

3.01 Installation

- .1 Install circuit breakers as per related sections.

End of Section

1 General

1.01 Section Includes

- .1 Fusible and non-fusible enclosed low-voltage disconnect switches from 30 to 800 amps.

1.02 Related Requirements

- .1 Section 26 28 13 – Fuses.

1.03 References

- .1 Canadian Standards Association
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (OESC) 27th Edition, 2018.
 - .3 CAN/CSA-C22.2 No. 4-16 – Enclosed and Dead-Front Switches.
 - .4 CSA C22.2 No. 248 series – Low-voltage fuses.
- .2 NETA (International Electrical Testing Association) ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 Submittals

- .1 Product Data: Provide switch ratings, and enclosure dimensions.

1.05 Closeout Submittals

- .1 Record actual locations of enclosed switches in project record documents.

2 Products

2.01 Manufacturers

- .1 Eaton Cutler-Hammer.
- .2 Siemens.
- .3 Square D by Schneider Electric.

2.02 Regulatory Requirements

- .1 Products: Listed and classified by CSA or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2.03 Disconnect Switches

- .1 Provide dedicated disconnect switches at electrical equipment.
- .2 Fused or un-fused disconnect or safety switches: Type "A", quick-make, quick-break construction with provision for padlocking switches in either "ON" or "OFF" position.
 - .1 Quick-make, quick-break.
 - .2 Heavy duty industrial type.

- .3 Lockable with up to 3 padlocks.
- .4 Cover interlocked with switch mechanism.
- .5 Viewing window for viewing blades.
- .3 Fused switches equipped with fuse clips designed for Class "J" fuses and designed to reject standard NEC fuses.
- .4 Enclosure: CSA Type 1 sprinkler-proof, or as noted.
- .5 Switches throughout project of same manufacturer.

3 Execution

3.01 Installation

- .1 Provide fused or un-fused safety or disconnect switches as shown and as required by Code.
- .2 Install disconnect switches complete with fuses, if applicable, to CSA C22.1.
- .3 Apply neatly typed adhesive tag on inside door of each fusible switch indicating NEMA fuse class and size installed.
- .4 Coordinate fuse ampere rating with installed equipment. Fuse ampere rating variance between original design information and installed equipment, size in accordance with Bussmann Fusetron 40 degree C recommendations. Do not provide fuses of lower ampere rating than motor starter thermal units.

End of Section

1 General

1.01 Section Includes

- .1 Common requirements for all electric lighting, including interior, exterior, and emergency lighting.

1.02 Related Requirements

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 51 19.00 – LED Interior Lighting.

1.03 References

- .1 CSA Group
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 9.0 - General Requirements for Luminaires.
 - .4 CSA C22.2 No. 250.0 - Luminaires (Bi-National Standard, with UL 1598).
 - .5 CAN/CSA E920-98 (R2017) - Ballasts for Tubular Fluorescent Lamps - General and Safety Requirements (Adopted IEC 920:1990, first edition, including Amendment 1:1993 and Amendment 2:1995, with Canadian deviations).
 - .6 CAN/CSA-E61347-2-3:03 (R2013) - Lamp controlgear - Part 2-3: Particular Requirements for A.C. supplied electronic ballasts for fluorescent lamps (Adopted CEI/IEC 61347-2-3:2000, first edition, 2000-10, with Canadian deviations).
- .2 Illumination Engineering Society (IES)
 - .1 IES HB-10-11 – The Lighting Handbook, 10th Edition.
 - .2 IES LM-79-08 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
 - .3 IES LM-80-08 – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- .3 NEMA WD 6 - Wiring Devices - Dimensional Requirements.

1.04 Submittals

- .1 Refer to Section 01 33 00.
- .2 General
 - .1 The Contractor shall be responsible for supplying equipment product data, and as indicated in the specification, partial or complete working samples of the specified equipment in a timely fashion for design team approval, prior to releasing orders on equipment. Contractor shall be responsible for coordinating all aspects of order placement, deposits, shop drawing procurement, order release, order follow-up, delivery tracking, etc. with Distributor in a timely fashion. Some luminaires may require at least 12 to 16 weeks of lead time or more- the Contractor is responsible for allowing sufficient time for the order-and-deposit process, shop drawing procurement, submittal, and review process. Substitutions will not be accepted on the basis of the contractor's obligation to make any deadlines, contractual or otherwise, agreed by the contractor toward the completion of this project. Lamp submittals are as important and necessary as luminaire submittals and must be supplied by the Contractor to assure correct lamp wattage, color and efficacy.
 - .2 All submittals shall be generated by respective factories with their seals or other authentication marks and each submittal sheet shall be clearly labeled with respective luminaire type, complete catalog number relevant to submitted

luminaire, date of submittal generation and name, phone number, and email address of submittal author in order to track provenance of information. The Consultant may contact respective factory submittal source.

- .3 The lighting equipment specified herein has been carefully chosen for its ability to meet the luminous environment requirements of this project. Calculations were typically made to determine luminances, luminance ratios, and/or horizontal and vertical illuminances and uniformities. In some instances, virtual reality "images" were generated with lighting calculation software to assist the Design Team and/or the Client in assessing the lighting quality of the spaces or areas. Equipment and/or manufacturers which have been shown to comply with the established criteria, including ASHRAE/IES 90.1 or California Title 24 or other such energy code as applicable by ordinance, code, Federal law, or mandate, and/or intended LEED or other green-building certification, is specified herein. Substitutions in all likelihood will be unable to meet all or some of the salient criteria as the specified equipment.
- .4 Where permitted, substitution submittals shall consist of a physical description, detailed dimensioned drawing and complete photometric and electric data of the proposed lamp, ballast, driver, or transformer as required, and luminaire. Working samples of lamp and luminaire substitutions must also be supplied at time of substitution request for visual check of finish, operating and photometric characteristics, and functional and aesthetic design. Photometric reports must list the actual candela values of the luminaire's distribution with specified or similar lamp in at least five horizontal planes with elevation angles in increments not greater than 5° from nadir to zenith. If additional data is required to account for asymmetric distributions, then this shall also be supplied. Candela curves, lux or footcandle and lumen tables and iso-lux-or-footcandle contours are not acceptable. The Contractor shall be responsible for negotiation with the client, Consultant, Lighting Designer, and Electrical Engineer prior to substitution submittal to assure fees are available for: redesign project based on proposed substitution ; or review by Consultant, Lighting Designer and Electrical Engineer of all photometric, sample, design and calculation documentation and virtual reality renderings (provided by Contractor) for proposed substitutions. All substitutions must be identified and approved prior to bid date; and all contractor negotiations re: additional fees for redesign work due to substitutions must occur prior to bid date. A Substitution Request Form shall be completed, submitted, and postmarked along with all relevant documentation required on the Substitution Request Form two weeks prior to bid date. No substitutions will be considered without compliance with this paragraph. Contractor's bid value and/or schedule commitments shall not be based on substitutions in expectation of design team approval, nor on Contractor estimated value of specified equipment. If submitted substitution fails to comply with any specification requirements or is rejected for any or no reason whatsoever, Contractor will furnish specified equipment at no additional cost or delay to the Owner.
- .5 The Contractor shall be responsible for obtaining from his supplying lighting manufacturers, for each luminaire, a recommended maintenance manual including:
 - .1 Vendor and local representative's contact information
 - .2 Tools required
 - .3 Instructions
 - .4 Types of cleaners to be used
 - .5 Replacement parts identification lists
 - .6 Equipment product data (high-quality reproducible copies)
 - .7 Warranty documentation
- .3 Shop Drawings:
 - .1 Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - .2 Wiring diagrams for power, signal and control wiring.
- .4 Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes and the following:

- .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 The product literature shall provide an explanation of all options and descriptors in the catalog number as submitted.
 - .3 Include luminaire weight.
 - .4 Provide complete photometric data prepared by independent testing laboratory for each luminaire, for approval by Engineer.
 - .5 Physical description of lighting fixtures including dimensions.
 - .6 Ballast, including BF.
 - .7 Energy-efficiency data, including ballast input wattage.
 - .8 Life, output (lumens, CCT and CRI), and energy efficiency data for lamps.
- .5 Photometric Data and Calculations
- .1 Provide Luminaire Data Photometric Testing performed by an independent agency complying with IESNA Lighting Measurement Testing and Calculation Guides.
 - .2 Submit photometric calculations for typical areas based on layouts as indicated on the drawings.
 - .1 Submit a photometric calculation for the typical areas based on the existing conditions.
 - .2 Submit a photometric calculation for the same typical areas based on the proposed new fixtures.
 - .3 Clearly indicate mounting heights, heights of calculation zones, light loss factors and surface reflectance values.
 - .4 Use the follow photometric parameters:
 - .1 Recoverable Light Loss Factors: 0.8
 - .2 Ceiling reflectance values of 80 per cent.
 - .3 Wall reflectance value of 50 per cent.
 - .4 Floor reflectance value of 20 per cent.
 - .3 Submittals shall be in PDF format, and the native file of the software used to make the photometric analysis.
 - .4 Submit IES photometric data files for the existing and proposed luminaires.

1.05 Closeout Submittals

- .1 Section 01 33 00 and Section 01 78 00: Submittals for project closeout.
- .2 Submit manufacturer's operation and maintenance instructions for each product.
- .3 Provide a list of all lamp types used on the project, use ANSI and manufacturer's codes.

1.06 Definitions

- .1 BF: Ballast factor.
- .2 CCT: Correlated colour temperature.

- .3 CRI: Colour-rendering index.
- .4 HID: High-intensity discharge.
- .5 LER: Luminaire efficacy rating.
- .6 LED: Light Emitting Diode.
- .7 Lumen: Measured output of lamp and luminaire, or both.
- .8 Luminaire: Complete lighting fixture, including ballast housing if provided.

1.07 Delivery, Storage, and Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Disposal and recycling of fluorescent lamps as per local regulations.

1.08 Maintenance Material Submittals

- .1 Refer to Section 01 78 00.
- .2 Extra Stock Materials:
 - .1 Provide an additional 2 per cent spare luminaires of each new type to be provided.
- .3 Spare Parts:
 - .1 Provide 1 per cent of each plastic lens type.
 - .2 Provide 2 per cent replacement lamps for each lamp type.
 - .3 Provide 1 per cent of each ballast type.
- .4 Tools: Provide three of each type of any special tools required for system use and maintenance.

1.09 Warranty

- .1 Refer to Section 01 78 00 and Section 26 05 00.
- .2 LED Luminaires shall have a manufacturer's warranty for a period of not less than five years.

2 Products

2.01 Luminaires

- .1 In accordance with related sections.

2.02 Regulatory Requirements

- .1 Products shall be listed and classified by CSA (Canadian Standards Association), ULC (Underwriter's Laboratories of Canada), or certified by recognized independent testing organizations that test to CSA standards.
- .2 All equipment and parts specified herein shall bear the "ULC Approved" label (or other NRTL label) indicating compliance with UL requirements or as otherwise allowed by the Authority Having Jurisdiction. All luminaires shall be ULC/ NRTL or CSA listed and labeled for installation in fireproof or non-fireproof construction, dry, damp, or wet locations as required.

2.03 Luminaire Disconnect Plugs

- .1 Shall be installed on all 120 V and 347 V luminaires before the ballast or LED driver inputs.
- .2 Shall be a bright colour to aid in identification as a safety device.
- .3 600V rated.
- .4 Types and application:
 - .1 3-wire disconnect plug to be used for all 3-wire ballasts, such as dimming ballasts using three-wire phase control.
 - .2 2-wire disconnect plug to be used on all other luminaires.
- .5 Code requirements:
 - .1 Listed to UL 2459.
 - .2 Listed to CSA 182.3.
- .6 Example Manufacturers:
 - .1 Thomas and Betts Marrette Series Luminaire Disconnect
 - .2 Ideal Industries Inc. PowerPlug Series Luminaire Disconnect

3 Execution

3.01 Installation

- .1 Install lighting equipment, including but not limited to luminaires, controls, auxiliary devices and the integration of same in strict conformance with all manufacturers' recommendations and instructions the securing of which shall be the responsibility of the Contractor.
- .2 Luminaires shall be integrated with controls in accordance with respective luminaire manufacturers' and controls manufacturers' recommendations and instructions and to provide a complete, trouble-free operation without compromising safety, code and UL/CSA/NOM requirements.
- .3 Contractor shall be responsible for sealing all outdoor luminaires for wet locations (i.e. all knock-outs, all pipe and wire entrances, etc.) as is standard industry practice to prevent water from entering luminaires.
- .4 The Contractor shall coordinate the lighting system installation with the relevant trades so as to eliminate interferences with hangers, mechanical ducts, sprinklers, pipes, steel, etc.
- .5 For installation in suspended ceilings, ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling system greater than 1/360 of the length of the total span of the ceiling member.
- .6 Mounting heights and configuration of the luminaires shall be as specified in the Luminaire Schedule portion of the Specification or indicated on the drawings, and where conflicts exist, as approved by the Consultant.
- .7 All luminaires shall be installed plumb and true and level as viewed from all directions unless specifically identified otherwise in the Luminaire Schedule. Luminaires shall remain plumb and true without continual adjustment or visibly obvious means beyond what is shown on luminaire submittal drawings.
- .8 Suspended luminaires shall be installed plumb and true and level unless specifically identified otherwise in the Luminaire Schedule portion of this Specification and at a height from finished floor as specified on the drawings, details and Luminaire Schedule. In cases where this is impractical, refer to the Consultant for a decision. All appurtenances shall be consistently organized for a neat, uniform appearance.

- .9 Luminaire finishes which are disturbed in any way during construction shall be touched up or refinished in a manner satisfactory to the Consultant.
- .10 Reflector cones, louvers, baffles, lenses, trims and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.
- .11 Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, a finishing ring painted to match the ceiling, shall be used to conceal the junction box.
- .12 All lamps shall be seasoned for a minimum of 12 hours and a maximum of 100 hours in full-on mode without dimming. All lamps used for convenience lighting during construction shall be replaced with identical new lamps, which shall then be seasoned as described above, immediately prior to the date of substantial completion as determined by the Consultant.
- .13 All accessories shall be properly installed and adjusted by Contractor in accordance with specification and installation instructions. Any spare items shall be clearly labeled (indicate type of accessory and associated luminaire types).
- .14 Locate and install luminaires as indicated.
- .15 Provide adequate support to suit ceiling system.
- .16 For fluorescent lighting, provide instant start ballasts for all areas with no occupancy sensors and program rapid start in areas with occupancy sensors.
- .17 Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- .18 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- .19 Install clips to secure recessed grid-supported luminaires in place.
- .20 Install wall mounted luminaires at height as indicated.
- .21 Install accessories provided with each luminaire.
- .22 Install specified lamps in luminaire.
- .23 Clean and re-lamp existing luminaires to be reused.
- .24 Check lighting luminaires and mountings for their electrical and physical characteristics in relation to conditions due to building construction and mechanical equipment. Make necessary adjustments to luminaires or hanging arrangement without expense to Owners. Give notification at time of shop drawings and before construction if decision on necessary changes is required.
- .25 Do not mount luminaires above pipes, ducts or equipment. In event of unavoidably tight locations, provide hangers to clear obstruction. Check layouts of other trades on job and plan co-operatively. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown.

3.02 Testing and Adjustment

- .1 As required, all adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Consultant. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor.
- .2 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.
- .3 The Contractor shall be responsible for notifying the Consultant of appropriate time for staking any outdoor luminaire locations which are called out as "to be field located" on drawings and Luminaire Schedule, and shall supply equipment and personnel for staking at the direction of the Consultant.

- .4 Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night.

3.03 Wiring

- .1 Install luminaire disconnect plugs on all new luminaires not provided as such from the manufacturer.
- .2 Connect luminaires to branch circuit outlets provided under Section 26 05 33.13 using flexible conduit.
- .3 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .4 Bond products and metal accessories to branch circuit equipment grounding conductor.

3.04 Luminaire Supports

- .1 Support luminaires independently of ceiling framing, unless ceiling is certified by the manufacturer to support weight of installed devices. Confirm if T-bar ceilings are metric or imperial and provide luminaires to suit ceiling dimensions.
- .2 Provide chain hangers for new and existing luminaires.

3.05 Luminaire Alignment

- .1 Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Recessed luminaires shall be installed to permit removal from below. Include accessories and materials to meet applicable codes and regulatory requirements.
- .2 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .3 Align luminaires mounted individually parallel or perpendicular to building grid lines.
- .4 Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

3.06 Field Quality Control

- .1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- .2 Wiring connections to the branch circuit shall be made using building wire with insulation suitable for temperature conditions within luminaire.
- .3 Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Ceiling framing members must be securely attached to each other and to the building structure as required by all applicable codes and standards. Use of integral clips is not acceptable.
- .4 Occupancy Sensors
 - .1 Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas.
 - .2 Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s).
 - .3 Exercise proper judgment in executing the work to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

3.07 Cleaning

- .1 All luminaires and accessories shall be thoroughly cleaned after being installed. All fingerprints, dirt, tar, smudges, drywall mud and dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens or louvers prior to final

acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufacturers' instructions.

- .2 Clean electrical parts to remove conductive and deleterious materials.
- .3 Remove dirt and debris from enclosures.
- .4 Clean photometric control surfaces as recommended by manufacturer.
- .5 Clean finishes and touch up damage.

3.08 Protection of Finished Work

- .1 Re-lamp luminaires that have failed lamps.
- .2 Re-lamp luminaires used for temporary lighting at Substantial Completion.

3.09 Commissioning

- .1 Measure samples of each new luminaire type to be replaced as described in PART 1 of this section for demonstration of energy savings.
- .2 Sensor placement and orientation for all sensor types.
- .3 Occupancy sensor function, sensitivity, and time delays.
- .4 Daylight harvesting sensor calibration.
- .5 Automated shade operation.
- .6 Manual control placement and operation.
- .7 Automated control operation, including scheduled on/off functions and dimming trims and presets.
- .8 Override operation, access, and functionality.
- .9 Centralized control interfaces and operation.
- .10 Client education of operations.
- .11 Documentation archived to client.

End of Section

1 General

1.01 Section Includes

- .1 Solid state, light emitting diode (LED) source interior luminaires.
- .2 New, fully integrated luminaires for indoor applications.

1.02 Related Requirements

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 50 00 – Lighting.
- .3 Section 26 51 19.16 – LED Retrofit Lamps.
- .4 Section 26 52 13.13 – Emergency Lighting.

1.03 References

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 9.0 - General Requirements for Luminaires.
 - .4 CSA C22.2 No. 250.0 - Luminaires (Bi-National Standard, with UL 1598).
- .2 DesignLights Consortium (DLC)
 - .1 Technical Requirements Table v2.1, or latest edition.
 - .2 Where the specifications do not explicitly call for DLC qualified LED luminaires, the technical criteria provided in the DLC Technical Requirements provide the basis of the requirements for this section of the Specification.
- .3 Energy Star
 - .1 Program Requirements for Luminaires - Eligibility Criteria, Version 1.2, or latest edition.
- .4 Illuminating Engineering Society (IES)
 - .1 IES HB-10-11 – The Lighting Handbook, 10th Edition.
 - .2 IES LM-79-08 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
 - .3 IES LM-80-08 – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 - .4 TM-21-11- IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.
- .5 National Electrical Manufacturer's Association (NEMA)
 - .1 SSL-1-10 – Electronic Drivers for LED Devices, Arrays, or Systems.
 - .2 WD 6 - Wiring Devices - Dimensional Requirements.

1.04 Definitions

- .1 CCT: Correlated colour temperature.

- .2 CRI: Colour-rendering index.
- .3 LED: Light Emitting Diode.
- .4 Lumen: Measured output of lamp and luminaire, or both.
- .5 Luminaire: Complete lighting fixture, including ballast housing if provided.

1.05 Action Submittals

- .1 Refer to Section 01 33 00 and Section 26 50 00.
- .2 Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but not limited to):
 - .1 Maximum power in Watts.
 - .1 If a transformer is used in conjunction with a driver (for example on some 347 volt lighting circuits), the maximum power shall include the transformer losses.
 - .2 L70 in hours, when extrapolated for the worse case operating temperature. TM-21 report shall be submitted to demonstrate this.
 - .3 Product submittals shall be accompanied by performance data that is derived in accordance with appropriate IESNA testing standards and tested in a laboratory that is NVLAP accredited for Energy Efficient Lighting Products.

1.06 Informational Submittals

- .1 Installation instructions.

1.07 Closeout Submittals

- .1 Section 01 33 00 and Section 01 78 00: Submittals for project closeout.
- .2 Submit manufacturer's operation and maintenance instructions for each product.

1.08 Regulatory Requirements

- .1 Products shall be listed and classified by CSA (Canadian Standards Association), ULC (Underwriter's Laboratories of Canada), or certified by recognized independent testing organizations that test to CSA standards.
- .2 Products shall be certified by a recognized testing agency accredited by the Standards Council of Canada and bear a certification mark from that agency.
- .3 All luminaires shall be listed and labeled for installation in fireproof or non-fireproof construction, dry, damp, or wet locations as required.
- .4 Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

1.09 Delivery, Storage, and Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.10 Extra Stock Materials

- .1 Refer to Section 01 78 00.

- 2 Provide the following additional equipment as listed herein.
 - .1 Provide an additional 2 per cent spare luminaires of each new type to be provided.
 - .2 Provide 1 per cent of each plastic lens type.
 - .3 Provide three of each type of any special tools required for system use and maintenance.

1.11 Warranty

- .1 Refer to Section 01 78 00 and Section 26 05 00.
- .2 The manufacturer shall provide a warranty against loss of performance and defects in materials and workmanship for the luminaires for a period of 5 years after acceptance of the luminaires. Warranty shall cover all components comprising the luminaire.
- .3 All warranty documentation shall be provided to customer prior to the first shipment.
- .4 LED Luminaires shall have a manufacturer's warranty for a period of not less than five years.
- .5 LED boards, drivers and associated components shall have a warranty of 5 years on the LEDs, 5 years on the driver, 10 years on the paint finish.

2 Products

2.01 Indoor LED Luminaires, General

- .1 Initial delivered lumens – thermal losses should be less than 10 per cent when operated at a steady state at an average ambient operating temperature of 25 degrees C, and optical losses should be less than 15 per cent.
- .2 Average Delivered Lumens – Average delivered lumens over 50 000 hours should be minimum of 85 per cent of initial delivered lumens.
- .3 All luminaires shall be tested per LM79/80 and published L70 data.
- .4 Available in 3500 K correlated colour temperature, CRI greater than or equal to 80, or as indicated.
- .5 Accessibility and Maintenance:
 - .1 All LED luminaires shall be field serviceable, with LED arrays, LED modules, drivers, etc. fully serviceable and easily accessible. In the case of recessed ceiling mounted, and in the case of surface mounted ceiling fixtures, these components must be accessible from below. Luminaires in which any of these components are accessible only from above are not acceptable.
 - .2 Ballasts, drivers, LED arrays, LED modules, and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts or drivers shall not be mounted to removable reflectors or wireway covers unless so specified. In the case of ceiling mounted luminaires, the serviceable components must be accessible from below.
- .6 Housings:
 - .1 Formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
 - .2 Sheet steel housings to be minimum 20 gauge.
 - .3 Wireways and fittings: free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.

- .4 When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
- .5 Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.
- .6 Drivers shall not be mounted to removable reflectors or wireway covers unless so specified.
- .7 Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- .8 Metal Finishes:
 - .1 Fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.
 - .2 All metal components of fixtures shall be painted after fabrication to mitigate raw metal edges, and thus prevent premature corrosion.
 - .3 The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
 - .4 Interior light reflecting finishes shall be white with not less than 85 per cent reflectance, except where otherwise shown on the drawing.
- .9 Wiring:
 - .1 Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
 - .2 Supplied complete with a luminaire disconnect plug.

2.02 Drivers, General

- .1 Electronic LED drivers shall be integral to the luminaire, and be designed to be accessible in the field for replacement and servicing.
- .2 Input Voltage:
 - .1 Driver with a voltage range of (120-277) +/- 10% or (347-480) +/- 10%.
 - .2 Refer to lighting fixture schedule.
 - .3 For luminaires connected to a 347 volt circuit and utilizing a natively 120-277 volt driver, provide an appropriately sized step down transformer.
- .3 Input frequency 60 Hz.
- .4 Load regulation: +/- 1 per cent from no load to full load.
- .5 Output ripple less than 10 per cent.
- .6 Output should be isolated.
- .7 Case temperature: rated for -40 degrees C through +80 degrees C.
- .8 Overheat protection, self-limited short circuit protection and overload protected.

- .9 Primary fused.
- .10 Driver life rating not less than 50 000 hours
- .11 Power Factor and Total Harmonic Distortion
 - .1 Power factor of greater than or equal to 0.9 at full load.
 - .2 THD of less than or equal to 20 per cent at full load.
- .12 Dimming Control:
 - .1 Coordinate with Section 26 09 23.
 - .2 0-10 V dimming control typical for all fixtures unless otherwise noted.
 - .3 Control range: 10 per cent to 100 per cent typical, unless noted otherwise.
 - .4 Provide a mock-up to demonstrate the luminaire is free of flicker throughout the dimming range when used with the dimming controllers described in related sections.

2.03 Downlight Luminaires

- .1 Minimum Light Output: 500 lm.
- .2 Zonal lumen density: Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
- .3 Minimum luminaire efficacy: 45 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.04 Nominal 305 mm by 1220 mm (1 foot by 4 foot) Luminaires for Ambient Lighting of Interior Spaces

- .1 Minimum Light Output: 1 500 lm.
- .2 Zonal lumen density:
 - .1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
- .3 Spacing Criteria:
 - .1 0 degrees to 180 degrees: 1.0 – 2.0
 - .2 90 degrees to 270 degrees: 1.0 – 2.0
- .4 Minimum luminaire efficacy: 85 lumens per watt.
- .5 Correlated Colour Temperature (CCT): 3500 K
- .6 Colour Rendition Index (CRI): 80 CRI minimum.
- .7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.05 Nominal 610 mm by 1220 mm (2 foot by 4 foot) Luminaires for Ambient Lighting of Interior Spaces

- .1 Minimum Light Output: 3 000 lm.

- .2 Zonal lumen density:
 - .1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
- .3 Spacing Criteria:
 - .1 0 degrees to 180 degrees: 1.0 – 2.0
 - .2 90 degrees to 270 degrees: 1.0 – 2.0
- .4 Minimum luminaire efficacy: 85 lumens per watt.
- .5 Correlated Colour Temperature (CCT): 3500 K
- .6 Colour Rendition Index (CRI): 80 CRI minimum.
- .7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.06 Linear Ambient Luminaires: Indirect

- .1 Minimum Light Output: 500 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.07 Linear Ambient Luminaires: Indirect/Direct

- .1 Minimum Light Output: 500 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 25 per cent between 0 degrees and 60 degrees from nadir.
 - .2 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.08 Linear Ambient Luminaires: Direct/Indirect

- .1 Minimum Light Output: 500 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.

- .2 Minimum 35 per cent between 90 degrees and 150 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.09 Linear Ambient Luminaires: Direct

- .1 Minimum Light Output: 375 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

3 Execution

3.01 Verification of Conditions

- .1 Coordinate the lighting system installation with the relevant trades so as to eliminate interferences with hangers, mechanical ducts, sprinklers, piping, steel, etc.

3.02 Installation

- .1 Install lighting equipment, including but not limited to luminaires, controls, auxiliary devices and the integration of same in strict conformance with all manufacturers' recommendations and instructions the securing of which shall be the responsibility of the Contractor.
- .2 Integrate luminaires with controls in accordance with respective luminaire manufacturers' and controls manufacturers' recommendations and instructions and to provide a complete, trouble-free operation without compromising safety, code and CSA requirements.
- .3 Seal all luminaires for wet locations (i.e. all knock-outs, all pipe and wire entrances, etc.) as is standard industry practice to prevent water from entering luminaires.
- .4 Luminaire Alignment
 - .1 Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Install recessed luminaires to permit removal from below. Include accessories and materials to meet applicable codes and regulatory requirements.
 - .2 Align luminaires mounted in continuous rows to form straight uninterrupted line.
 - .3 Align luminaires mounted individually parallel or perpendicular to building grid lines.
 - .4 Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

- .5 Locate and install luminaires as indicated. Mounting heights and configuration of the luminaires shall be as specified in the Luminaire Schedule portion of the Specification or indicated on the drawings, and where conflicts exist, as approved by the Consultant.
 - .6 Installed all luminaires plumb and true and level as viewed from all directions unless specifically identified otherwise in the Lighting Fixture Schedule. Luminaires shall remain plumb and true without continual adjustment or visibly obvious means beyond what is shown on luminaire submittal drawings.
 - .7 For installation in suspended ceilings, ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling system greater than 1/360 of the length of the total span of the ceiling member.
- .5 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
 - .6 Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, use a finishing ring painted to match the ceiling to conceal the junction box.
 - .7 Suspended Luminaires:
 - .1 Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
 - .2 Suspended luminaires shall be installed plumb and true and level unless specifically identified otherwise in the Luminaire Schedule portion of this Specification and at a height from finished floor as specified on the drawings, details and Luminaire Schedule. In cases where this is impractical, refer to the Consultant for a decision. All appurtenances shall be consistently organized for a neat, uniform appearance.
 - .8 Install wall mounted luminaires at height as indicated.
 - .9 Accessories:
 - .1 Reflector cones, louvers, baffles, lenses, trims and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.
 - .2 Install accessories provided with each luminaire.
 - .3 All accessories shall be properly installed and adjusted by Contractor in accordance with specification and installation instructions. Any spare items shall be clearly labeled (indicate type of accessory and associated luminaire types).

3.03 Testing and Adjustment

- .1 As required, all adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Consultant. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor.
- .2 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.
- .3 Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night.

3.04 Luminaire Supports

- .1 Provide adequate support to suit ceiling system.
- .2 Support luminaires independently of ceiling framing, unless ceiling is certified by the manufacturer to support weight of installed devices. Confirm if T-bar ceilings are metric or imperial and provide luminaires to suit ceiling dimensions.
- .3 Provide chain hangers for new and existing luminaires.
- .4 Install clips to secure recessed grid-supported luminaires in place.

- .5 Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Ceiling framing members must be securely attached to each other and to the building structure as required by all applicable codes and standards. Use of integral clips is not acceptable.

3.05 Wiring

- .1 Install luminaire disconnect plugs on all new luminaires not provided as such from the manufacturer.
- .2 Connect luminaires to branch circuit outlets provided under Section 26 05 33.13 using flexible conduit.
- .3 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .4 Bond products and metal accessories to branch circuit equipment grounding conductor.

3.06 Field Quality Control

- .1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- .2 Make wiring connections to the branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .3 Occupancy Sensors.
 - .1 Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas.
 - .2 Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room.
 - .3 Exercise proper judgment in executing the work to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

3.07 Cleaning

- .1 Thoroughly clean all luminaires and accessories after installation. All fingerprints, dirt, tar, smudges, drywall mud, dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens or louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufacturers' instructions.
- .2 Clean electrical parts to remove conductive and deleterious materials.
- .3 Remove dirt and debris from enclosures.
- .4 Clean photometric control surfaces as recommended by manufacturer.
- .5 Clean finishes and touch up damage.
- .6 Luminaire finishes which are disturbed in any way during construction shall be touched up or refinished in a manner satisfactory to the Consultant.

3.08 Commissioning

- .1 In accordance with Section 26 08 50.

End of Section

1 General

1.01 Conditions and Requirements

- .1 Refer to the General Conditions, Supplementary General Conditions, and General Requirements.
- .2 Provisions of this Section shall apply to all Sections of Division 27.
- .3 Refer to Consultant's drawings for exact location of electrical equipment and devices. Refer to Designer drawings for additional notes which complement these specifications.
- .4 The Division 26 specification documents shall be followed in conjunction with the specification in this section.

1.02 Related Requirements

- .1 Division 25 – Integrated Automation.
- .2 Division 26 – Electrical.
- .3 Division 28 – Electronic Safety and Security.

1.03 Intent

- .1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter. Sections of this specification are not intended to delegate functions nor to delegate work and supply to any specific Trade. It shall be your responsibility to ensure that the systems specified hereafter are complete and operative.

1.04 Reference Standards

- .1 The equipment, material and installation shall conform to the latest version of the applicable Codes, Standards (including technical service bulletins and addenda) and regulations of authorities having jurisdiction.
- .2 BICSI
 - .1 Telecommunications Distribution Methods Manual
 - .2 Cabling Installation Manual
 - .3 Outside Plant Manual
- .3 Canadian Standards Association (CSA)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA T529 – Commercial Building Telecommunications Cabling Standard (ANSI/EIA/TIA-568-B).
 - .4 CSA T530 – Commercial Building Standard For Telecommunications Pathways And Spaces (TIA/EIA 569-A).
 - .5 CSA T528 – Administration Standard For The Telecommunications Infrastructure Of Commercial Buildings (ANSI/EIA/TIA-606).
 - .6 CSA T527 – Commercial Building Grounding And Bonding Requirements For Telecommunications (ANSI/EIA/TIA-607).
 - .7 CSA C22.2 No. 214 – Communications Cables.
 - .8 CSA C22.2 No. 232-M – Fibre Optic Cables.

- .9 CSA C22.2 No. 182.4-M90 – Plugs, Receptacles, and Connectors for Communication Systems.
- .4 TIA
 - .1 TIA/EIA-568-B.1 – Commercial Building Telecommunications Cabling Standard
 - .2 TIA/EIA-568-B.2 – Balanced Twisted Pair Cabling Components
 - .3 TIA/EIA-568-B.3 – Optical Fibre Cabling Components Standard
- .5 ISO
 - .1 ISO/IEC IS 11801A – Generic Cabling for Customer Premises.
- .6 CENELEC EN 50173 – Performance Requirements for Generic Cabling Schemes.
- .7 IEC
 - .1 IEC 603-7, PART 7 – Detailed Specification For Connectors, 8-Way, Including Fixed And Free Connectors With Common Mating Features.
 - .2 IEC 807-8 – Rectangular Connectors For Frequencies Below 3 MHz, Part 8: Detailed Specification For Connectors, Four-Signal Contacts And Earthing Contacts For Cable Screens, First Edition.
- .8 FIPS PUB 174 – Commercial Building Telecommunications Wiring Standard. Federal Information Standard Publication.
- .9 UL 444 and 13 – Adopted Test and Follow-Up Service Requirements For the Optional Qualification of 100Ω Twisted-Pair (Cables).
- .10 NEMA WC 63 – Performance Standard For Field Testing Of Unshielded Twisted-Pair Cabling System.
- .11 ANSI/EIA/TIA
 - .1 ANSI/EIA/TIA-492AAAA – Detailed Specification For 62.5µm Core Diameter / 125µm Cladding Diameter Class 1a Multimode, Graded-Index Optical Waveguide fibres.
 - .2 ANSI/EIA/TIA-492BAAA – Detailed Specifications For Class Iva Dispersion-Unshifted Singlemode Optical Waveguide Fibres Used In Communication Systems.
 - .3 ANSI/EIA/TIA-472CAAA – Detailed Specifications For All Dielectric (Construction 1) Fibre optic Communications Cable For Indoor Plenum Use, Containing Class 1a, 62.5µm Core Diameter / 125µm Cladding Diameter Fibre optic(s).
 - .4 ANSI/EIA/TIA-472DAAA – Detailed Specifications For All Dielectric Fibre optic Communications Cable For Outdoor Plant Use, Containing Class 1, 62.5µm Core Diameter / 250µm Cladding Diameter Fibre optic(s).
 - .5 ANSI/EIA/TIA-455 – Test Procedures For Fibre optics, Cables And Transistors.
 - .6 ANSI/EIA/TIA-598 – Colour Coding of Fibre Optic Cables.
 - .7 ANSI/EIA/TIA-604-3 – FOCIS 3 Fibre Optic Connector Intermateability Standard.
 - .8 ANSI/EIA/TIA-606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 - .9 ANSI/EIA/TIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.
- .12 ANSI Z136.2 – American Standards For The Safe Operation of Fibre optic Communication Systems Utilizing Laser Diode And LED Sources.
- .13 ANSI/CEA

- .1 ANSI/ICEA S-83-640 – Fibre Optic Outside Plant Communications Cable.
- .2 ANSI/ICEA S-83-596 – Fibre Optic Premises Distribution Cable.

1.05 Submittals

- .1 Before delivery to site of any item of equipment, the electrical contractor shall submit 6 copies of shop drawings c/w all data, pre-checked and stamped accordingly, for approval to the Engineer. Indicate project name on each brochure or sheet. Submit shop drawings within 1 week after award of contract, for the following:
 - .1 Copper Cabling
 - .2 Fibre Optic Cabling
 - .3 Fabric Innerduct
 - .4 Racks, managers
 - .5 Patch Panels
 - .6 Telecommunications Outlets, Faceplates
 - .7 Fibre Optic Routing System
 - .8 Rack Power Distribution Units

1.06 Record Documentation

- .1 To Section 01 78 00.
- .2 Red lines, mark-ups by this contractor.

1.07 Operation and Maintenance Manuals

- .1 Refer to Division 01.

1.08 Inspections

- .1 The Engineer and/or the Project Manager will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.

1.09 Drawings and Specifications

- .1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a ruling is to be obtained from the Engineer in writing before submitting Tender. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.
- .2 All drawings and all Divisions of these specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.
- .3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of cabling is not assured. Exact requirements shall be governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull and junction boxes, etc. necessitated by such conditions shall be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.
- .4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job.

- .5 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
- .6 Before ordering any conduit, cable tray, cables, fittings, etc., this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.10 Material

- .1 This contractor is responsible to ensure that all items submitted meet all requirements of the drawings and specification, and fits in the allocated space. The final determination of a product being acceptable shall be determined by the Engineer.

1.11 Testing Data

- .1 The contractor shall provide a complete testing report utilizing a testing device as specified in the applicable TIA/EIA standard with the correct adapter and test. All copper tests shall be compliant to the current TIA/EIA standards: Perm Link or Channel.
- .2 The Summary report shall be provided to the end user in a universal format so that there is no need to purchase any software to read and print the report.
 - .1 Utilizing Adobe Acrobat is an acceptable manner.

1.12 Painting and Finishes

- .1 Minor damages to finish on factory finished equipment shall be touched up to the Engineer's satisfaction. Items suffering major damage to finish shall be replaced at the direction of the Engineer. Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.

1.13 Safety

- .1 The Contractor shall be responsible for the safety of his workmen and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations shall prevail.

1.14 Warranty

- .1 Submit a written performance warranty to the Owner for two years for the complete installation from the date of testing and acceptance.
- .2 The contractor shall also provide a two years labour warranty on the installation.

2 Products

2.01 Material Approval

- .1 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.
- .2 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical Inspection Services, or other government agency.

3 Execution

3.01 Workmanship and Contractor's Qualifications

- .1 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Engineer. Any unsatisfactory workmanship will be replaced at no extra cost.
- .2 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this Specification. This Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all equipment and materials in dry locations.
- .3 Provide foreman in charge of this work at all times.
- .4 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker's Compensation, and Employer's Liability Insurance.

3.02 Work Sequence

- .1 Prior to start of each work period in occupied area, temporary protection shall be installed to prevent damage to any personal property or furnishing. Coordinate with Owner's representative if any furniture must be relocated to facilitate work.
- .2 Owner's representative shall approve temporary protection plan prior to use.
- .3 Necessary steps shall be taken by contractor to ensure that required fire fighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

3.03 Coordination

- .1 Coordinate work with other trades.
- .2 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report all necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.
- .3 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Cooperate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other Trades.

3.04 Manufacturers' Instructions

- .1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.
- .2 Follow manufacturer's instructions where they cover points now specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.05 Quality Assurance

- .1 See General Provisions of the Contract.
- .2 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.
- .3 The Contractor shall ensure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.

- .4 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.

3.06 Labels and Signs

- .1 Labelling shall be as per TIA/EIA-606.

3.07 Adjust and Clean-Up

- .1 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this Trade. At the completion of this work, the installation is to be left in a clean and finished condition to the satisfaction of the Engineer.

3.08 Tests and Acceptance

- .1 The operation of the equipment does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfils the requirements of the drawings and the specifications.
- .2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.
- .3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition. In the presence of the Owner, the Contractor shall demonstrate the proper operation of all miscellaneous systems.

End of Section

1 General

1.01 Description

- .1 This section specifies general grounding and bonding requirements of telecommunication installations for equipment operations.
- .2 “Grounding electrode system” refers to all electrodes required by Electrical Code, as well as including made, supplementary, telecommunications system grounding electrodes.
- .3 The terms “connect” and “bond” are used interchangeably in this specification and have the same meaning.

1.02 Related Requirements

- .1 Section 09 69 00 – Access Flooring.
- .2 Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- .3 Section 27 11 16 – Communications Cabinets, Racks, Frames, and Enclosures.

1.03 References

- .1 Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM B1-2001 - Standard Specification for Hard-Drawn Copper Wire.
 - .2 ASTM B8-2004 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- .3 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - .1 IEEE 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- .4 Canadian Standards Association (CSA):
 - .1 CSA C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (25th Edition / 2012).
- .5 Telecommunications Industry Association, (TIA)
 - .1 TIA J-STO-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .6 Underwriters Laboratories, Inc. (UL):
 - .1 UL 44-2005 - Thermoset-Insulated Wires and Cables.
 - .2 UL 83-2003 - Thermoplastic-Insulated Wires and Cables.
 - .3 UL 467-2004 - Grounding and Bonding Equipment.
 - .4 UL 486A-486B-2003 - Wire Connectors.

1.04 Submittals

- .1 Submit in accordance with Section 01 33 00.
- .2 Shop Drawings:

- .1 Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
- .2 Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- .3 Test Reports: Provide certified test reports of ground resistance.
- .4 Certifications: Two weeks prior to substantial performance, submit four copies of the following:
 - .1 Certification that the materials and installation is in accordance with the drawings and specifications.
 - .2 Certification, by the Contractor, that the complete installation has been properly installed and tested.

2 Products

2.01 Grounding and Bonding Conductors

- .1 Equipment grounding and bonding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation colour shall be continuous green for all equipment grounding conductors. Cable insulation shall be plenum rated (CMP).
 - .1 Example: American Insulated Wire Corp, Telcoflex III series.
- .2 Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.
- .3 Telecom System Grounding Riser
 - .1 Telecom System Grounding Riser Conductor: Telecommunications Grounding Riser shall be in accordance with J STO-607A. Use a minimum 50mm² (1/0 AWG) insulated stranded copper grounding conductor unless indicated otherwise.

2.02 Telecommunication and Equipment Ground Busbars

- .1 Provide solid copper busbar, pre-drilled from two-hole lug connections with a minimum thickness of 6 mm (1/4 inch) for wall and backboard mounting using standard insulators sized as per details on the electrical drawings.
- .2 Manufacturers:
 - .1 Newton Instrument Company.
 - .2 Panduit.
 - .3 Burndy.
 - .4 Thomas and Betts.

2.03 Splices and Termination Components

- .1 Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.04 Ground Connections

- .1 Above Grade:
 - .1 Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.

- .2 Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
- .3 Rack and Cabinet Ground Bars: two-hole compression-type lugs using zinc-plated or copper alloy fasteners.

3 Execution

3.01 General

- .1 Ground in accordance with the Electrical Code, as shown on drawings, and as hereinafter specified.
- .2 Equipment Grounding: IT cabinets, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.02 Secondary Equipment and Circuits

- .1 Conduit Systems:
 - .1 Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - .2 Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
 - .3 Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- .2 Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- .3 Boxes, Cabinets, Enclosures, and Panelboards:
 - .1 Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 - .2 Provide lugs in each box and enclosure for equipment grounding conductor termination.
 - .3 Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- .4 Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

3.03 Corrosion Inhibitors

- .1 When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.04 Telecommunications System

- .1 Bond telecommunications system grounding equipment to the electrical grounding electrode system.
- .2 Furnish and install all new wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.
- .3 Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.

- .4 Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milliohms or less.
- .5 Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.
- .6 Bonding Jumpers:
 - .1 Use insulated ground wire of the size and type shown on the Drawings or use a minimum of #6 AWG insulated copper wire.
 - .2 Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
 - .3 Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.
- .7 Bonding Jumper Fasteners:
 - .1 Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.
 - .2 Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.
 - .3 Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
 - .4 Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

3.05 Communications Raceway Grounding

- .1 Conduit: Use insulated #6 AWG bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.
- .2 Wireway: use insulated #6 AWG bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.

End of Section

1 General

1.01 Summary

- .1 Provide a complete system of empty conduit, pull boxes, outlets, and sleeves for enclosure of wiring by communications cabling.

1.02 Related Requirements

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.03 References

- .1 BICSI Telecommunications Distribution Methods Manual, 13th Edition (2014).

2 Products

2.01 Outlets

- .1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.
- .2 Provide 53 mm conduit through walls as noted.

2.02 Conduits

- .1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.
- .2 Minimum conduit size shall be 21 mm diameter.
- .3 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .4 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations for later cable installation by others.
- .5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.
- .6 Provide a minimum of two 5-15R duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 Installation

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8 inch nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by future installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 Section Includes

- .1 Provide a complete system of empty conduits, pull boxes, outlets, and sleeves for enclosure of wiring by other under Cash Allowance. Refer to General Requirements.

1.02 Related Requirements

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.
- .3 Section 28 46 21.11 – Addressable Fire Alarm Systems.

1.03 References

- .1 BICSI Telecommunications Distribution Methods Manual, 13th Edition (2014).

2 Products

2.01 Outlets

- .1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.

2.02 Conduits

- .1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.
- .2 Minimum conduit size shall be 21 mm diameter.
- .3 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .4 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations for later cable installation by others.
- .5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with two coats of fire retardant light grey enamel.
- .6 Provide a minimum of two duplex receptacles on separate circuits at each backboard.
- .7 Provide fire alarm over-ride feature at fire alarm control panel (FACP) to deactivate public address system when Fire Alarm System is in alarm.

3 Execution

3.01 Installation

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.
- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit bends shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30,000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by Cash Allowance installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 Summary

- .1 Provide a complete system of empty conduits, terminal cabinets, plywood backboards, pull boxes and outlets for enclosure of wiring by Security Contractor under Cash Allowance.

1.02 Related Requirements

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.

2 Products

2.01 Outlets

- .1 Wall and door outlets shall be single boxes, or 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted. Coordinate with Security Contractor.

2.02 Conduits

- .1 Provide conduit in all walls, exposed areas and inaccessible ceilings. All conduit work shall be concealed.
- .2 Minimum conduit size shall be 21 mm diameter.
- .3 Provide J hooks in accessible ceilings for plenum rated wiring.
- .4 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Plywood backboards shall be minimum 1200 x 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.
- .6 Provide a minimum of 2 duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 Installation

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.
- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.

- 4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 m in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- 5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by Security installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 Summary

- .1 The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the system of non-continuous cable supports (“J-Hooks”) as described in this specification.

1.02 Scope

- .1 Non-continuous cable supports.
- .2 Adjustable non-continuous cable support sling.
- .3 Multi-tiered non-continuous cable support assemblies.
- .4 Non-continuous cable support assemblies from tee bar.
- .5 Non-continuous cable support assemblies from drop wire/ceiling.
- .6 Non-continuous cable support assemblies from beam, flange.
- .7 Non-continuous cable support assemblies from C & Z Purlin.
- .8 Non-continuous cable support assemblies from wall, concrete, or joist.
- .9 Non-continuous cable support assemblies from threaded rod.
- .10 Raised floor non-continuous cable support assemblies.
- .11 Cantilever-Mounted Option for non-continuous cable supports.
- .12 Installation accessories for non-continuous cable supports.

1.03 Definitions

- .1 UTP: Unshielded twisted pair.
- .2 ANSI: American National Standards Institute
- .3 ASTM: American Society for Testing and Materials
- .4 EIA: Electronic Industries Alliance
- .5 TIA: Telecommunications Industry Association
- .6 cULus: Listed by Underwriters Laboratories based on both Canadian and US (United States) standards requirements.

1.04 Submittals

- .1 Submit product data on non-continuous cable support devices, including attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.

1.05 Quality Assurance

- .1 Non-continuous cable supports and cable support assemblies shall be listed by Underwriters Laboratories for both Canadian and US standards (cULus).
- .2 Non-continuous cable supports shall have the manufacturers name and part number stamped on the part for identification.

2 Products

2.01 Manufacturers

- .1 ERICO, Inc.
- .2 Eaton B-Line.

2.02 References

- .1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
- .2 ASTM B 695-90 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel
- .3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- .5 ASTM A109 Standard Specification for Steel, Strip, Carbon, Cold-Rolled
- .6 ASTM A167 Standard Specification for Stainless and heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- .7 ASTM A480/A480M Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- .8 ASTM A568 Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy Hot-Rolled and Cold-Rolled
- .9 A653 G60-Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip process
- .10 ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- .11 ASTM A682 Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality
- .12 ASTM A879 Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
- .13 ASTM B117 Standard Method of Salt Spray (Fog) Testing
- .14 ASTM D610 Standard test Method for Evaluating Degree of Rusting on Painted Steel Surfaces UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.
- .15 ANSI/ TIA/ EIA 568 Commercial Building Telecommunications Cabling Standard, current revision level.
- .16 ANSI/ TIA/ EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces, current revision level.
- .17 NFPA 70 National Electrical Code®

2.03 Non-Continuous Cable Support Systems

- .1 Non-continuous cable supports
 - .1 Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.
 - .2 Non-continuous cable supports shall have flared edges to prevent damage while installing cables.

- .3 Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
 - .4 Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
 - .5 Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply.
 - .6 Non-continuous cable supports shall be ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CMTM Double J-Hook CAT100CM; CAT-CMTM U-hook series CAT200CMLN, CAT300CMLN; and CAT-CMTM retainer CATRT200CM, CATRT300CM.
- .2 Adjustable non-continuous cable support sling
 - .1 Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable; cULus Listed.
 - .2 Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
 - .3 Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.
 - .4 If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.
 - .5 Acceptable products: ERICO CADDY CableCat™ CAT425.
 - .3 Multi-tiered non-continuous cable support assemblies
 - .1 Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.
 - .3 The multi-tiered support bracket shall consist of ERICO CADDY CATHBA and CableCat™ J-Hooks with screws.
 - .4 Non-continuous cable support assemblies from tee bar
 - .1 Tee bar support bracket with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 Acceptable products: ERICO CADDY CAT12TS, CAT21528, CAT32528.
 - .5 Non-continuous cable support assemblies from drop wire/ceiling
 - .1 Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 Acceptable products: ERICO CADDY CAT124Z34, CAT126Z34, CAT214Z34, CAT216Z34, CAT324Z34 or CAT326Z34.
 - .6 Non-continuous cable support assemblies from beam, flange
 - .1 Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

- 2 Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY beam clamps and CADDY flange clips.
- .7 Non-continuous cable support assemblies from C & Z Purlin
 - .1 Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.
 - .2 Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY Purlin hangers.
- .8 Non-continuous cable support assemblies from wall, concrete, or joist
 - .1 Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.
 - .2 Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64, with CADDY angle bracket.
- .9 Non-continuous cable support assemblies from threaded rod
 - .1 Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.
 - .2 The multi-tiered support bracket shall have a static load limit of 300 lbs.
 - .3 U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.
 - .4 Acceptable products: ERICO CableCat™ J-hook, CAT12, CAT21, CAT32, CAT64 with CADDY CATHBA series; CAT-CMTM Double J-hook CAT100CM, CAT-CMTM Direct mount U-hook CAT200CMLN, CAT300CMLN; or AFAB series.
- .10 Raised floor non-continuous cable support assemblies
 - .1 Fastener to raised (access) floor pedestal with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 Acceptable products: ERICO CADDY CAT12CD1B, CAT21CD1B or CAT32CD1B; CAT64CD1B.
- .11 Cantilever-Mounted cable supports
 - .1 U-hook shall be able to be assembled to a wide variety of wall mount brackets.
 - .2 Spacing of individual U-hooks as needed, max of 4' to 5' apart.
 - .3 U-hooks may have the optional attachment of a cable roller for ease in pulling cables.
 - .4 Acceptable products: ERICO CAT-CMTM U-hooks CAT200CMLN, CAT300CMLN; CAT-CM roller assemblies CATRL200CM, CATRL300CM; CATWMCM bracket.
- .12 Installation accessories for non-continuous cable supports
 - .1 Cable Pulley
 - .1 Non-continuous cable supports may be used as an installation tool when a removable pulley assembly is included. The pulley shall be made of plastic and be without sharp edges. The pin and bail assembly must be able to be secured to the J-Hook during cable installation. The pulley must remain secured while cables are being pulled.
 - .2 The pin and roller assembly must be removed after cables are installed.
 - .3 Acceptable products: ERICO CADDY CAT32PLR, CAT64PLR.

- .2 Cable Protector
 - .1 The protective steel tube shall fit over threaded rod and be at least 4" in length.
 - .2 The tube shall prevent damage to cables placed in or pulled through CAT-CMTM U-hooks. The tube shall not inhibit the pulling of cables.
 - .3 Acceptable products: ERICO CAT-CMTM CATTBCM.

2.04 Finishes

- .1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
- .2 ASTM B 695 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel
- .3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- .5 Non-continuous cable supports used where only mildly corrosive conditions apply shall be stainless steel, AISI type 304.

3 Execution

3.01 Installation

- .1 Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
- .2 Install cables using techniques, practices, and methods that are consistent with Category 5 or higher requirements and that supports Category 5 or higher performance of completed and linked signal paths, end to end.
- .3 Install cables without damaging conductors, shield, or jacket.
- .4 Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
- .5 Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.
- .6 Do not exceed load ratings specified by manufacturer.
- .7 Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
- .8 Follow manufacturer's recommendations for allowable fill capacity for each size non-continuous cable support.

End of Section

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1 General

1.01 Section Includes

- .1 Firestopping through penetrations in fire rated assemblies.

1.02 Related Requirements

- .1 Section 07 84 00 – Firestopping.

1.03 References

- .1 ASTM E 84, “Surface Burning Characteristics of Building Materials”.
- .2 ASTM E 119, “Fire Tests of Building Construction and Materials”.
- .3 ASTM E 814, “Fire Tests of Penetration Firestop Systems”.
- .4 ANSI/UL263, “Fire Tests of Building Construction and Materials”.
- .5 ANSI/UL723, “Surface Burning Characteristics of Building Materials”.
- .6 ANSI/UL1479, “Fire Tests of Through Penetration Firestops”.
- .7 Underwriters Laboratories Inc. (UL) – Fire Resistance Directory

1.04 Performance Requirements

- .1 Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, additions and changes will occur, such devices shall:
 - .1 Meet the hourly rating of the floor or wall penetrated.
 - .2 Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.
 - .3 Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:
 - .1 Opening or closing of doors.
 - .2 Twisting an inner liner.
 - .3 Removal or replacement of any material such as, but not limited to, sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.
 - .4 Permit multiple devices to be ganged together to increase overall cable capacity.
 - .5 Allow for retrofit to install around existing cables.
 - .6 Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes.
- .2 Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.

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- .3 Where non- mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.
- .4 Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.
- .5 Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

1.05 Submittals

- .1 Submit under provisions of Section 01 33 00.
- .2 Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.
- .3 Shop Drawings: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- .4 Certificates: Product certificates signed by firestop system manufacturer certifying material compliance with applicable code and specified performance characteristics.
- .5 Installation Instructions: Submit manufacturer's printed installation instructions.

1.06 Quality Assurance

- .1 Products/Systems: Provide firestopping systems that comply with the following requirements:
 - .1 Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.
 - .2 Firestopping products bear the classification marking of qualified testing and inspection agency.
- .2 Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

1.07 Delivery, Storage, and Handling

- .1 Delivery:
 - .1 Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multicomponent products.
 - .2 Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.
- .2 Storage and Protection:
 - .1 Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

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1.08 Project Conditions

- .1 Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
- .2 Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.
- .3 Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- .4 Do not use materials that contain flammable solvents.
- .5 Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- .6 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- .7 Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

2 Products

2.01 Manufacturers

- .1 Specified Technologies Inc.
200 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.
- .2 Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

2.02 Materials

- .1 General: Use only firestopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

2.03 Fire Rated Cable Pathways

- .1 Steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
 - .1 Specified Technologies Inc. (STI) EZ-PATH Fire Rated Pathway.

3 Execution

3.01 Examination

- .1 Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.
- .2 Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.
- .3 Provide masking and temporary covering to protect adjacent surfaces.
- .4 Do not proceed until unsatisfactory conditions have been corrected.

2022-02-11

3.02 Installation

- .1 General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

3.03 Field Quality Control

- .1 Keep areas of work accessible until inspection by authorities having jurisdiction.
- .2 Where deficiencies are found, repair firestopping products so they comply with requirements.

3.04 Adjusting and Cleaning

- .1 Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
- .2 Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

End of Section

1 General

1.01 Purpose

- .1 To verify that installations are in accordance with project requirements.
- .2 To ensure proper system operation.

1.02 Commissioning Organizations

- .1 Certified member of Electrical Contractors Association of Ontario (ECAO) or Canadian Fire Alarm Association (CFAA.)

1.03 Related Requirements

- .1 Section 01 91 13 – General Commissioning Requirements.

2 Products – Not Used

3 Execution

3.01 Procedures

- .1 Follow manufacturer's recommendations for testing.
- .2 Inspect wiring connections to all devices comprising the system.
- .3 Verify supervision of wiring at every device connection to a supervised circuit.
- .4 Test operation of every device on a system to verify its function.
- .5 Examine equipment for any apparent damage or tampering that may interfere with its intended operation.
- .6 Test equipment with capabilities for field adjustment to establish that it functions as intended under the conditions prevailing at its point of installation.
- .7 Examine devices for evidence of damage or obstructions which may interfere with their operating mechanisms.
- .8 Test automatic devices by simulating an operating condition.
- .9 Wiring:
 - .1 Inspect every device and test to demonstrate that disconnection of the device from the circuit or malfunction of the equipment or wiring activates the required supervisory signals. Inspection shall include verification that:
 - .1 Supervisory signals operate in response to open circuits, short circuits, ground faults and disconnection of plug-in components;
 - .2 Terminations of conductors entering and leaving equipment have been made;
 - .3 Circuit polarities are in accordance with the system design, where applicable.
 - .2 In addition, test to establish that the power supplied to any device is within its recommended operating range and that the required voltage levels are maintained and that the fusing is correct.
- .10 Initiating Devices - Manual:
 - .1 Inspect manual alarm stations in consideration of the following:

- .1 The device shall be mounted with sufficient clearance to facilitate ease of access and proper operation;
 - .2 Operate each manual alarm station, toggle switch and key switch to verify proper functions.
- .11 Automatic heat detectors:
- .1 Use a heat source reproducible in its intensity, as recommended by the manufacturer of the device, to initiate an alarm.
 - .2 Test equipment - Heat lamp or Air heater. DO NOT USE AN OPEN FLAME HEAT SOURCE.
 - .3 Apply heat source as to not damage or operate fusible disc parts.
- .12 Automatic heat detectors - non-resettable:
- .1 Test by simulating its electrical operation by jumpering the wiring points (creating a short) adjacent to its operating mechanism.
- .13 Automatic smoke detectors - area type:
- .1 Test by introducing smoke into its detecting chamber. This may consist of actual smoke from burning materials or artificially generated smoke aerosol spray as recommended by the manufacturer. The sensitivity should be noted and adjusted if necessary.
- .14 Automatic smoke detectors:
- .1 Examine the air sampling arrangements of the detectors under actual conditions of balanced air circulation by conducting a check of the field sensitivity and a check of the air velocity in accordance with the manufacturers' recommendations.
 - .2 Test gas to be used similar to Automatic Smoke Detector.
- .15 Alarm signals - audible:
- .1 Test on main power supply and standby power supply with the maximum expected load on the system.
 - .2 The audible signalling appliances shall function as intended and shall be audible throughout the building over the background noise present.
 - .3 Decibel recordings in each area covering 100 sq. metres shall be taken.
 - .4 The level of sound should usually be 15 dB above ambient noise level.
- .16 Alarm signals - visual:
- .1 The visual signal appliances shall function as intended and shall be clearly visible.
- .17 Fire suppression supervision:
- .1 Coordinate with the requirements of Section 21 12 00, and Section 21 13 00.
 - .2 Sprinkler and standpipe trade to active each sprinkler and standpipe supervisory and alarm device by operating valves and producing flows as required in conjunction with fire alarm technician to observe activation of flow switches, pressure switches, supervised valves, etc.
- .18 Annunciators, printers and workstations:
- .1 Inspect and operate to establish that their operation in conjunction with the control equipment and other system components, is as intended. The equipment shall be inspected to ensure:

- .1 The zone of each alarm initiating device is properly indicated;
 - .2 The legend is clearly visible;
 - .3 Adequate voltage under local conditions is present;
 - .4 Wiring connections have been made in a workmanlike manner.
 - .5 Proper care must be taken to establish that each item is complete and satisfactory.
- .19 Standby power supplies - batteries:
- .1 Examine batteries for possible damage and consideration of the following:
 - .1 The charging system functions as intended;
 - .2 The installation has not resulted in the bypassing of a fuse or a similar protective device;
 - .3 The installation protects the batteries from accidental or mechanical damage.
 - .4 The batteries must be able to operate the fire alarm system with the charger input disconnected for one rated load cycle.
- .20 Control equipment and transponders:
- .1 Test to establish that they function as intended. The following examinations and tests shall be performed:
 - .1 A visual and physical inspection of all cables, plug interconnections, plug-in circuit components, lamps, sockets and controls to establish that their mechanical and electrical connections and mounting are as required for intended function and, where applicable, to confirm electrical supervision;
 - .2 Verification that all field wiring is terminated in a workman-like manner;
 - .3 All lamps and indicators shall be tested for operation and intended function;
 - .4 All keypad functions shall be tested for operation and intended function;
 - .5 All control unit functions shall be operated to verify appropriate response including all software routines and programme functions are simulated;
 - .6 Simulation of open circuits, short circuits and ground faults on all relevant internal circuits in order to confirm the appropriate supervisory response;
 - .2 Commissioning Report:
 - .1 Provide in accordance with requirements of Section 01 91 13, supplemented as specified herein.
 - .2 Report to include relevant information of the system including:
 - .3 Each system part described.
 - .4 How the system is operated.
 - .5 What functions the system performs.
 - .6 Requirements for tests and service.
 - .7 Itemization of all devices connected on the system, their general location.

- .8 The date of the performed tests.
- .9 All pertinent details of the report sheets requested.
- .3 Verification:
 - .1 The Commissioning Report to be submitted to the Commissioning Manager upon completion of commissioning and will be subject to verification by the Commissioning Manager.

End of Section

1 General

1.01 Section Includes

- .1 Spot Smoke Detectors.
- .2 Duct mounted smoke detectors.
- .3 Residential smoke alarms.
- .4 Accessories.

1.02 Related Requirements

- .1 Section 28 46 21.11 – Addressable Fire Alarm Systems.

1.03 Unit Prices

- .1 Refer to Document 00 43 00.26.
- .2 Submit with Tender unit prices to provide the following:
 - .1 Provide fire detector (heat detector or smoke detector) complete with wiring and conduit, based on 10 metre distance.
 - .2 Provide duct type smoke detector complete with wiring and conduit on a separate zone, based on 30 metre distance.
 - .3 Provide wire guard for any fire alarm device.

1.04 Extra Stock Materials

- .1 Supply the following additional equipment as spare parts in a proper metal enclosure sized to accept the equipment as listed herein. Label the enclosure fire alarm spare parts. Enclosure shall be placed in the same room as the FACP.
 - .1 Supply three of each type of addressable detector base, smoke detector heat detector.
- .2 Provide (supply and install) an additional five of each of the following fire alarm devices as directed during construction. Turn over unused surplus in addition to those devices listed above:
 - .1 Smoke detectors.
 - .2 Heat detectors.

2 Products

2.01 Analytical Microprocessor Addressable Detectors – General

- .1 Early warning analog addressable detectors shall use state-of-the-art multi-sensor 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 4000 feet minimum using #18 AWG 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 detector’s on-board microprocessor 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 an e-mail 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.

2.02 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 degrees C to 49 degrees C (32 degrees F to 120 degrees F).
 - .2 Humidity: 0-93% RH, non-condensing.
 - .3 Elevation: no limit.

2.03 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 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.
- .4 Install duct smoke detectors in heated areas (indoors).

2.04 Detector Bases – Standard

- .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. Bases will have the option of external LED operation, Relay Base or Data Line Isolator Base.

2.05 Detector Base – Relay

- .1 The relay base shall support all Addressable Detector types and have the following requirements:
 - .1 Form “C” contacts rated at 1 amp @ 30 VDC 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.
- .2 For added survivability, relay operation shall be controlled by the detectors microprocessor. The relay shall be capable or operation in the conventional stand-alone mode in the event communication is lost with the loop controller. Relay bases not controlled by the detector’s microprocessor shall not be acceptable.

2.06 Residential Smoke Alarms

- .1 Self-contained, standalone, 120 volt AC interconnectable combination carbon monoxide and smoke alarm to measure for harmful levels of carbon monoxide or smoke, and activate a distinct audible and visual alarm in either condition.
- .2 Complete with temporary silencing, and test/reset button.
- .3 Certified to CSA C6.19.
- .4 When interconnected, detectors all sound an alarm. An LED visual signal indicates the detector that initiated the alarm.
- .5 Basis of design: Chubb Edwards EST 900 series.

3 Execution

3.01 Installation

- .1 Installation to Section 28 46 21.11.
- .2 Provide wire guards for heat detectors in gymnasiums.

3.02 Residential Smoke Alarm Installation

- .1 Install in accordance with manufacturer's instructions.
- .2 Circuit from same breaker as the washroom lighting.

3.03 Identification

- .1 Provide an engraved phenolic nameplate, red text on red background at the ceiling location below any concealed duct mounted smoke detectors indicating "Smoke Detector Above – DSD-1" where DSD-1 is the identification of the detector. Locate on lay-in ceiling grid or access hatch where located.

3.04 Field Tests and Inspections

- .1 Testing, and inspection to Section 28 46 21.11.
- .2 Verification to Section 28 46 21.11.

End of Section

1 General

1.01 Section Includes

- .1 Intelligent Modules.
- .2 Fire Alarm Pull Stations for Single Stage Fire Alarm Systems.

1.02 Related Requirements

- .1 Section 21 05 23 - General-Duty Valves for Water-Based Fire Suppression.
- .2 Section 26 05 00 – Common Work Results for Electrical.
- .3 Section 28 46 21.11 – Addressable Fire Alarm Systems.

1.03 References

- .1 CAN/ULC-S528, Manual Stations for Fire Alarm Systems.

1.04 Extra Materials

- .1 Provide (supply and install) an additional five of each of the following fire alarm devices as directed during construction. Turn over unused surplus in addition to those devices listed above:
 - .1 Zone Addressable Modules (ZAMs).
 - .2 Manual pull stations.

2 Products

2.01 Microprocessor Based Intelligent Modules

- .1 General
 - .1 Zone Addressable Modules (ZAM) shall be used for the monitoring of water flow, valve tamper, fire suppression control panels, non-addressable detectors, and for control of fans or dampers that require shutdown or manual control in an alarm condition.
 - .2 Monitor ZAM's shall monitor any N/O contact device and be capable of powering 2-wire smoke detectors. The ZAM will communicate the zone's status (normal, alarm, trouble) to the transponder. The ZAM's zone address shall be set at the time of installation via a dip switch package.
 - .3 Control ZAM's shall be able to provide supervised or non-supervised control of any control function. The ZAM will communicate the zone's status (normal, trouble) to the transponder. Each control ZAM shall provide a double pole double throw relay for switching loads of up to 120 VAC. Each common leg of the relay shall be equipped with a replaceable 2 Amp fuse. The ZAM's zone address shall be set at the time of installation via a dip switch package.
 - .4 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. 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. 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. 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. 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. 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
- .2 Single Input Module:
- .1 Microprocessor-based Addressable Modules shall be used to provide one (1) supervised Class A input circuit capable of latching operation for use with contact devices, non-damped Waterflow Switches, non-latching supervisory sprinkler switches.
- .3 Dual Input Module:
- .1 Microprocessor-based Addressable Modules shall be used to provide two (2) independent supervised Class A 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 water flow operation shall have an automatic delay of 15 seconds before reporting the water flow 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.
- .4 Monitor Module:
- .1 The Microprocessor-based Addressable Monitor Module shall be factory set to support one (1) supervised Class A 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.
- .5 Control Relay Module:
- .1 Microprocessor-based Addressable Control Relay Modules shall provide one form “C” dry relay contact rated at 2 amps @ 24 V DC or 0.5 amps at 120 V AC 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.

2.02 Microprocessor Based Addressable Manual Pull Stations

- .1 Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
- .2 Stations must be designed such that after an actual activation, they cannot be restored to normal without the use of a special tool.
- .3 All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
- .4 Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 44 mm or larger.
- .5 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.
- .6 The manual station shall be suitable for mounting on a North American 1-1/2 inch (38 mm) deep, 4 inch square electrical box with 1/2 inch (13 mm) raised cover.

- .7 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 per cent RH, non-condensing.
- .8 Pull Station Cover
 - .1 Where noted on the drawings Manual Fire Alarm pull stations shall be provided with a clear, tamperproof, polycarbonate shield and frame that fits over manual pull stations. When lifted to gain access to the actual alarm, it shall sound a 95 dB or 105 dB warning horn.
 - .2 The cover is connected to the frame by a cable. When the cover is lifted, it hangs off of the frame and the horn will sound until the cover is snapped back onto the frame (or for the life of the battery).
 - .3 Battery shall be provided for each cover.
 - .1 Tamper or protecting covers for manual stations shall comply with CAN/ULC-S528, Including Accessories.
- .9 Pull stations shall be addressable, single action, non-coded, single stage, semi-flush mounted type.
- .10 The approximate location of all initiating devices is shown on the drawings. All existing initiating devices shall not be disturbed unless absolutely necessary to facilitate installation of a new device. No existing devices are to be disturbed without specific authorization by the Project Manager.
- .11 Provide a total of twenty (20) keys for resetting of manual stations.

3 Execution

3.01 Installation

- .1 Installation to Section 28 46 21.11.
- .2 Install manual pull stations at 1200 mm above finished floor.
- .3 Where possible, install the manual station on the latch side of a single door at a maximum lateral distance of 1500 mm (59 in) from the door opening.
- .4 Install manual pull stations on both sides of a series of doors exceeding 12 m (39 feet) in total width, and within 1500 mm (59 in) of each side of the opening.

3.02 Testing and Inspection

- .1 Testing, and inspection to Section 28 46 21.11.

3.03 Verification

- .1 Verification to Section 28 46 21.11.

End of Section

1 General

1.01 Section Includes

- .1 Single stage addressable fire alarm systems.
- .2 System testing and verification.
- .3 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing, and putting into proper operation a complete Fire Alarm System as shown, as specified, and as otherwise required. Complete system shall be left ready for continuous and efficient satisfactory operation.

1.02 Related Requirements

- .1 Section 08 71 00 – Door Hardware: additional requirements for access control devices, magnetic door holders, etc.
- .2 Section 21 10 00 – Water-Based Fire-Suppression Systems.
- .3 Section 26 05 00 – Common Work Results for Electrical.
- .4 Section 26 05 83.14 – Elevator Equipment Wiring.

1.03 Unit Prices

- .1 Refer to Tender Form Document.
- .2 Submit with Tender unit prices to provide the following:
 - .1 Provide manual pull station complete with wiring and conduit based on 10 metre distance.
 - .2 Provide fire alarm horn/strobe complete with wiring and conduit, based on 10 metre distance.
 - .3 Provide smoke detector complete with wiring and conduit, based on 10 metre distance.
 - .4 Provide duct type smoke detector complete with wiring and conduit on a separate zone, based on 30 metre distance.
 - .5 Provide cost of additional conduit and wire for the above items.

1.04 References

- .1 Definitions
 - .1 FACP: Fire Alarm Control Panel. This is the central component of a fire alarm/detection/communication system and consists of a control panel(s) and contains the system power supply, system CPU, circuit terminations, and system annunciation functions.
 - .2 INITIATION DEVICE: Examples are smoke detectors, heat detectors, water flow switches, valve tamper switches, and manual pull stations. These are devices which initiate a signal and send it to the FACP telling it that an abnormal event has taken place. Data Centre extinguishing systems, kitchen hood extinguishing systems, and other special extinguishing system control panels are additional examples of initiating devices.
 - .3 NOTIFICATION DEVICE: Examples are alarm horns, alarm speakers, and strobe lights. These devices are used to indicate through visual and audible means the existence of an abnormal event throughout all areas of the protected premises.
 - .4 CONTROL DEVICE: Examples are electronic relays or solenoids. These devices allow the FACP to automatically take certain actions during an abnormal event. For example, the FACP may energize a relay which, in turn, shuts down an air handling unit.

- .5 CENTRAL PROCESSING UNIT (CPU): The central computer of a multiplex fire alarm system.
- .6 CONCEALED: Where used in connection with installation of piping or conduit and accessories shall mean "hidden from sight" as in shafts, furred spaces, soffits or above suspended ceilings.
- .7 EXPOSED: Where used in connection with installation of piping or conduit and accessories shall mean "visible" or "not concealed."
- .8 AHJ: Authority Having Jurisdiction.
- .9 LISTED: Materials or equipment included in a list published by a nationally recognized laboratory that maintains periodic inspection of production of listed equipment and materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.
- .10 NFPA: National Fire Protection Association.
- .11 CLASS A: Applies to wiring from transponder to central processing unit. The CPU will detect circuit trouble and transponder will retain the ability to transit alarm upon a single fault condition.
- .12 CLASS B: Applies to wiring from initiating device to transponder. A trouble signal will be transmitted to the panel upon a single fault condition.
- .13 TRANSPONDER: Single or multiple zone/point data collection panel used within a multiplex system.
- .14 UL and ULC: Underwriters Laboratories, Inc., and Underwriters Laboratories of Canada, Inc.
- .15 ULC Listed: Materials or equipment listed by Underwriters Laboratories of Canada and included in the most recent edition of the UL and ULC Fire Protection Equipment Directory.
- .16 AHU: Air Handling Unit.
- .17 FM: Factory Mutual Research Corporation/Factory Mutual Engineering Association.
- .2 Reference Standards
 - .1 The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only. The equipment and installation shall comply with the latest edition/amendment referenced code, standard, or publication.
 - .1 Canadian Standards Association
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code, 25th Edition / 2012.
 - .3 CSA C22.2 No. 208-14 - Fire Alarm and Signal Cable.
 - .2 Ontario Regulations
 - .1 Ontario Building Code.
 - .2 Ontario Fire Code.
 - .3 Underwriters Laboratories of Canada Standards
 - .1 CAN/ULC-S524 – Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S525 – Audible Signal Appliances for Fire Alarm Systems

- .3 CAN/ULC-S526 – Visual Signal Appliances for Fire Alarm Systems
- .4 CAN/ULC-S527 – Control Units for Fire Alarm Systems.
- .5 CAN/ULC-S528 – Manual Pull Stations for Fire Alarm Systems
- .6 CAN/ULC-S529 – Smoke Detectors for Fire Alarm Systems.
- .7 CAN/ULC-S530 – Heat Detectors for Fire Alarm Systems
- .8 CAN/ULC-S533 – Egress Door Securing and Releasing Devices
- .9 CAN/ULC-S536 – Inspection and Testing of Fire Alarm Systems
- .10 CAN/ULC-S537 – Verification of Fire Alarm Systems
- .11 CAN/ULC-S548 – Alarm Initiating and Supervisory Devices for Water Type Extinguishing Systems
- .12 ULC/ORD 693 – Central Station Fire Protective Signaling
- .4 All requirements of the Authority Having Jurisdiction (AHJ).
- .2 In the case of any discrepancy between these specifications, the project drawings, and any applicable local codes, the installed Fire Alarm / Life Safety System shall comply with the most stringent requirement.

1.05 Action Submittals

- .1 In accordance with Section 01 00 00.
- .2 Shop Drawings: Provide annunciator layout and system wiring diagram showing each device and wiring connection required.
- .3 Product Data: Provide electrical characteristics and connection requirements.
- .4 Test Reports: Indicate satisfactory completion of required tests and inspections.
- .5 Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.
- .6 Submit drawings to municipal Fire Department, showing annunciation devices, manual pull stations, complete wiring diagrams and annunciator details and obtain their approval.
- .7 Shop Drawings:
 - .1 Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - .2 Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, and device arrangement.
 - .3 Show annunciator layout and main control panel module layout, configurations and terminations.
 - .4 Show device layout, complete riser diagram, and auxiliary functions.
 - .5 The supplier of the system shall prepare a complete zoning schedule and artwork layout for passive graphic to be included with submittal package.

1.06 Closeout Submittals

- .1 Maintenance Contracts

- .1 Provide service and maintenance of fire alarm system for one year from Date of Substantial Completion.
- .2 Operation and Maintenance Data
 - .1 Operation Data: Operating instructions.
 - .2 Maintenance Data: Maintenance and repair procedures.
- .3 Record Documentation
 - .1 Record actual locations of initiating devices, signaling appliances, and end-of-line devices.
 - .2 Electrical Safety Authority (ESA) inspection certificate.
 - .3 Fire alarm verification report.
 - .4 Audibility test.
- .4 Manuals
 - .1 Submit complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets (with model numbers to be used indicated).
 - .2 Wiring diagrams shall indicate terminals and the interconnections between the items of equipment.
 - .3 Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment.

1.07 Extra Stock Materials

- .1 Supply the following additional equipment as spare parts in a proper metal enclosure sized to accept the equipment as listed herein. Label the enclosure fire alarm spare parts. Enclosure shall be placed in the same room as the FACP.
 - .1 Supply two keys for each of the control panel and annunciator panel.
 - .2 Supply three of each type of addressable detector base, smoke detector and heat detector.
 - .3 Supply three of each type of any special tools required for system use and maintenance.
 - .4 Any unused additional devices from the quantity noted on the drawings.

1.08 Quality Assurance

- .1 Manufacturer shall examine drawings and specifications prior to award of contract to ensure that detectors, control panels and miscellaneous devices being supplied will provide a satisfactory working installation.
- .2 Each and all items of the fire alarm system shall be listed as the products of a single manufacturer under the appropriate category by Underwriters Laboratories of Canada and shall bear the "ULC" label.
- .3 The fire alarm control, panel shall meet the modular listing requirements of ULC. Each subassembly of the FACP, including all printed circuit boards, shall include the appropriate ULC modular label.
- .4 Each and all items of the fire alarm system shall be covered by a one-year parts and labour warranty covering defects resulting from faulty workmanship and materials. The warranty shall be deemed to begin on the date the system is accepted by the Project Manager on issuance of the substantial performance certificate for the project.
- .5 Regulatory Requirements
 - .1 Provide products listed and classified by ULC as suitable for purpose specified and indicated.

.6 Qualifications of Manufacturer

- .1 Equipment and materials shall be provided by an experienced reputable manufacturer to ensure proper specification adherence, final connection, test, turnover, warranty compliance, and service.
- .2 The manufacturer is required to have been in the fire alarm industry (service and installation) for a minimum of ten years.
- .3 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.
- .4 International Standards Organization. The system and all components will be manufactured to ISO 9001 international Quality Management and Quality Assurance Standards.
- .5 Manufacturer must have service facilities within a 50 km radius of the installation location.

.7 Qualifications of Installers

- .1 All work performed to comply with this specification shall be carried out by and/or managed by a competent firm regularly engaged in the installation and testing of fire alarm systems for commercial buildings. All subcontractors of the contractor including the chosen fire alarm equipment distributor shall also be competent firms which are regularly engaged in the design, installation, testing, and servicing of fire alarm systems for commercial buildings.
- .2 Review of cut-sheets, shop drawings, calculations and other materials submitted by the contractor shall not relieve the contractor's responsibility for full compliance with the design drawings and specification unless written approval is requested by the contractor and obtained from the Consultant for each non-complying feature. Finalized agreements for all equipment deviations from the drawings and specification shall be completed prior to award of the installation contract.
- .3 For those instances where the contractor cannot conform to the drawings and specification, a proposed variance shall be submitted in writing to the Consultant at least five working days prior to the bidding date. The Consultant will respond to all proposed variances within two working days of receipt.
- .4 All questions concerning interpretation of the design drawings and specification shall be submitted to the Consultant in writing no later than three working days prior to the bidding date. Requests for interpretations received after this date will not be answered. The Consultant will respond to all requests for interpretations in writing and will provide a summary of each request and the response to all bidding contractors. The Consultant will respond to all requests for interpretations within two working days of receipt.
- .5 The contractor shall utilize the services of a fire alarm equipment distributor who is a factory authorized representative and a full line stocking distributor of the equipment manufacturer and shall maintain a constant inventory of the parts typical of those used in the system installation covered under this specification.
- .6 The contractor, installation subcontractor, and the fire alarm equipment manufacturer or distributor shall each have a minimum of 7 years of continuous experience in the design and/or installation of fire alarm systems and shall have completed a minimum of five projects of similar scope and complexity which were completed using addressable/analog systems. It is intended that these projects incorporated the same equipment, manufacturer and model number, as is being proposed for this project. To verify the qualifications, the contractor, installing subcontractor, and the fire alarm equipment distributor shall submit a brief design narrative which covers at least five fire alarm systems selected for references. This narrative shall indicate the project location, approximate contract value, system size by device counts, and a functional overview. These narratives shall provide an end-user contact name and telephone number for each referenced system. Where a fire alarm equipment distributor is a branch office of a fire alarm manufacturer, the references shall be chosen from projects in which the branch office completed both the design implementation and the installation.

- .7 The Owner reserves the right to request documentation from the contractor with respect to any pending litigation against the contractor or any subcontractor. Further, the Owner reserves the right to review an audited financial statement of the contractor or any subcontractor for the most recently completed fiscal year.
- .8 The Owner reserves the right to disqualify any contractor who does not comply with all requirements of the Contractor Performance Standard of this specification.
- .9 Installer must be certified by the Province of Ontario as a fire alarm installer.

1.01 Delivery, Storage, and Handling

- .1 In accordance with Section 01 61 00.

1.02 Warranty

- .1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one year from the date of acceptance.

2 Products

2.01 Manufacturers

- .1 All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality.
 - .1 Edwards EST3X series from Chubb Fire & Security.
- .2 All equipment and components shall be the manufacturer's current model.
- .3 The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system.
- .4 The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- .5 The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications.
- .6 Manufacturer is to support a 20 year product.

2.02 Conduit and Wire for Fire Alarm System

- .1 Conduit:
 - .1 In accordance with Section 26 05 33.13.
 - .2 Conduit shall be in accordance with the Electrical Safety Authority (ESA), local and provincial requirements.
 - .3 All wiring shall be installed in conduit or raceway.
- .2 Terminal Boxes, Junction Boxes and Cabinets:
 - .1 All boxes and cabinets shall be listed for their purpose and use.
- .3 Fire Alarm Cable

- .1 Wiring shall be in accordance with local, provincial and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as outlined in the Ontario Electrical Safety Code and as recommended by the fire alarm system manufacturer.
- .2 All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signalling system, as outlined in the Ontario Electrical Safety Code.
- .3 Conductors: 300V rated multiconductor, insulated, colour coded, copper conductor, minimum size to be #16 AWG for device loops and 14 AWG for signal circuits.
- .4 Certified by CSA as fire alarm and signal cable type FAS 105 to CSA C22.2 No. 208.
- .5 Non-Fire rated cable:
 - .1 Insulation: 105 degrees C flame retardant PVC
 - .2 Outer Jacket: 105 degrees C flame retardant PVC Red.
 - .3 Armour: Interlocking aluminum without overall Jacket. For drops to devices in suspended ceilings from conduit system.
- .6 Fire rated fire alarm cable:
 - .1 Pentair Pyrotenax 1850 series mineral insulated (MI) cable with 2 hour fire rating to ULC S139 and to meet Ontario Building Code Rule 3.2.7.10.
 - .2 Alternates such as "Lifeline" installed in conduit may only be considered if listed by ULC under ULC Category Code 'FHJRC' after October 2014.
 - .3 Acceptable alternate: VITALink MC Brand Type MC, manufactured by Marmon Wire & Cable Inc. (listed by ULC under ULC category code 'FHJRC', dated 19 May 2015).

2.03 Addressable Fire Alarm System

- .1 The system to be electrically supervised, non-coded, annunciated, single stage, addressable fire alarm system using addressable devices.
- .2 The Central Processing Unit (CPU) uses multiplex communication techniques to receive data from and transmit data to transponders remotely located throughout facility to minimize wiring costs, simplify design, to allow economical expansion and easy retrofit.
- .3 Make provisions during detailed design for future expansion of the system.
- .4 System to be complete with a minimum of three data loops per node.
- .5 The CPU is microprocessor-based to increase system reliability, speed response to alarm conditions, and reduce cost. CPU response time to alarm conditions to be no more than four seconds, regardless of system size.
- .6 Fire alarm system will be zoned as required plus 25 per cent spares.
- .7 Basic Performance:
 - .1 Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
 - .2 Provided with an emergency power supply, i.e. batteries capable of providing supervisory power for not less than 24 hours, and immediately following, emergency power under full load for not less than two hours.

2.04 Fire Alarm Annunciator Panel (FAAP) and Static Graphic

- .1 Annunciator panels
 - .1 An annunciator panel, located at the ground floor lobby (firefighter's entrance), will have an alphanumeric display for each detection device, and will identify the detection device initiating an alarm.
 - .2 The panel shall be installed in a recessed enclosure with brushed aluminum finish to suit the construction of the vestibule. Coordinate exact location and dimensions with Architectural drawings.
 - .3 Identify emergency exit door numbers/identifiers, and on the control panel/annunciator panel LED labels in order to identify the manual pull stations adjacent to said doors when being activated when cross referenced with the passive graphic.
- .2 Passive Graphic Display
 - .1 Provide passive colour graphic display to be mounted adjacent to the fire alarm control panel and each annunciator panel as indicated on the drawings. Plastic laminate type, on white background, framed by stainless steel frame and under glass, 600 mm by 600 mm (24 inch by 24 inch) minimum size.
 - .2 Different brilliant colours shall be used to distinguish the various fire alarm zones and building outline from one another and shall be silk-screened with durable acrylic-based inks on a white matte 1/8-inch thick acrylic sheet.
 - .3 Provide a minimum of six different colours.
 - .4 Graphical display will indicate the following at minimum. Coordinate between all trades for inclusion of this information.
 - .1 "YOU ARE HERE" shall be indicated in red (unique to each passive graphic location).
 - .2 Indicate the extents of all fire alarm zones, and the location of sprinkler and standpipe monitoring devices (including designations).
 - .3 Indicate the extents of zones served by air handling units with shut downs.
 - .4 Indicate the location of the fire alarm control panel, all annunciators, and network panels/nodes.
 - .5 Indicate the location of Sprinkler Room(s), and all supervised fire protection devices. Coordinate with the fire protection trade(s) for exact locations of devices.
 - .6 Emergency exit doors with door numbers shown. These will be needed to cross reference with the annunciator panel labels for pull stations that are activated next to these doors.
 - .7 Label all Stair Letters. Designations to match Architectural drawings.
 - .8 Main gas shut off location.
 - .5 Allow for other requirements per the Authorities Having Jurisdiction, including the Municipal Building Inspector, and Municipal Fire Inspector.

2.05 Signalling and Annunciation Devices

- .1 Manual stations, smoke detectors, heat detectors, strobes and speakers are fully supervised.
- .2 System will monitor the fire sprinkler system devices.

2.06 Fire Alarm Initiation Devices

- .1 Fire Detection Sensors (Heat Detectors): to Section 28 46 11.

- 2 Smoke Detection Sensors: to Section 28 46 11.
 - .1 Ionization Smoke Detectors
 - .2 Duct Smoke Detectors
 - .1 Provide duct smoke detectors in accordance with CAN/ULC-S524.
- .3 Manual Pull Stations: to Section 28 46 12.
- .4 Flow Switches and Supervised Valves
 - .1 Connect to flow switches as described in Division 21.

2.07 Door Hold Open Devices

- .1 Provide auxiliary relay to disconnect door holders upon fire alarm.
- .2 Furnish and install where shown on the drawings, magnetic door holders designed for positive release to secure openings as indicated for limiting smoke spread. The units furnished shall be brushed aluminum finish, compatible with the doors as listed in the door schedule as follows:
 - .1 120 Vac concealed wiring with 25 lb holding force.
 - .2 120 Vac surface wiring with 25 lb holding force.
 - .3 120 Vac recessed door with 25 lb holding force.
 - .4 120 Vac floor mounting, single door with 25 lb holding force.
 - .5 120 Vac floor mounting, double door with 25 lb holding force.
 - .6 120 Vac sliding door with 120 lb holding force, grey hammer-tone finish.
 - .7 120 Vac overhead door with 120 lb holding force, grey hammer-tone finish.
- .3 Smoke detectors shall be provided on both sides of doors with hold open devices. Smoke detectors shall be complete with auxiliary relay bases, connected to release the respective hold open device.

2.08 Signalling Devices

- .1 Horns and Strobes: to Section 28 46 23.11.
 - .1 Strobe Frequency
 - .1 Strobe frequency shall have a maximum of 5 Hz.
- .2 Programmable Electronic Sounders:
 - .1 Shall be flush mounted as required.
- .3 Audible/Visual Combination Devices:
 - .1 Shall meet the applicable requirements listed above for audibility.
 - .2 Shall have a built in strobe, 15 candela.
- .4 Strobe Synchronizing Modules:
 - .1 Synchronize strobes at 1 Hz and horns at temporal over single wire pan.

2.09 Operation

- .1 An alarm is caused by actuation of any one of the following devices:
 - .1 Pulling a manual station.
 - .2 Operation of an automatic fire alarm detector
 - .3 Operation of a sprinkler flow switch
 - .4 Operation of a smoke detector
- .2 If, in any area of the building, an alarm is caused by actuation of the aforementioned devices, the following shall occur:
 - .1 Signals in the building shall sound.
 - .2 Annunciators shall indicate exact zone where alarm originated
 - .3 Fans shall be automatically turned off.
- .3 Central station shall be automatically alerted via telephone lines connected for fire alarm system.
- .4 If, in any area of the building, supervised valves of the sprinkler, systems are operated or exhibit short or open circuits, the following shall occur:
 - .1 The annunciator shall identify, as a separate zone, the item causing the trouble signal.
 - .2 The trouble buzzer on the annunciator(s) shall sound.
 - .3 The signals in the building shall not be sounded.

2.10 Operation Sequences

- .1 Upon operation of any manual station, heat detector, smoke detector, or sprinkler water flow, the following is to occur:
 - .1 Initiate alarm origin on CPU and at graphic annunciator
 - .2 Display the alarm event on all annunciator panels.
 - .3 Actuate CPU causes evacuation signal to sound and strobes to operate.
 - .4 The internal audible device shall sound at the control panel.
 - .5 Signal transmission to external systems:
 - .1 Transmit signal to monitoring station.
 - .6 Door Releases:
 - .1 All stairwell/exit doors shall unlock throughout the building.
 - .2 All self-closing fire/smoke doors held open shall be released.
 - .3 Site entrance and exit gates open.
 - .7 Elevator:
 - .1 Provide elevator recall functions for primary and alternate floors and elevator power shunt trip activation for each elevator.

- .2 Each elevator lobby smoke detector shall be complete with relay base. Provide five relays and interconnecting wiring to elevator controller for elevator recall. Coordinate requirements with elevator supplier.
- .8 HVAC Shutdowns:
 - .1 Shut down air supply and return air fans.
 - .2 Activate smoke dampers.
- .9 CPU indicates trouble when any fault occurs within the system
- .2 Supervisory
 - .1 The activation of a sprinkler supervised valve or pressure switch shall initiate the following sequence of operation:
 - .1 The control panel and remote annunciator shall indicate exact location of activity via a zoned AMBER LED
 - .2 Activate an audible tone on the control panel and remote annunciator
 - .3 The signals in the building shall not be sounded.
- .3 Trouble
 - .1 A short, ground fault or open circuit to any fire alarm conductor, the tamper or removal of any field device or the loss of primary or standby power to any control equipment will result in the following trouble sequence of operation:
 - .1 The control panel and remote annunciator shall indicate exact location of activity via a zoned YELLOW LED.
 - .2 Activate an audible tone on the control panel and remote annunciator.
 - .3 The signals in the building shall not be sounded.

2.11 Monitoring Transmitter

- .1 Owner's monitoring vendor to provide monitoring transmitter adjacent to the fire alarm control panel in the Custodian Room.
- .2 Contractor to provide one dedicated 15A/120 volt circuit for monitoring transmitter at communications entrance facility for use by Monitoring Transmitter.

3 Execution

3.01 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.
- .2 The contractor shall furnish all labour, conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for a complete, functional life safety fire alarm system.
- .3 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 Canadian Electrical Code and the Inspection Authority.
- .4 All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.
- .5 Power supply:

- .1 Connect fire alarm system power supply to a dedicated circuit.
- .2 Circuit breaker(s) feeding fire alarm system to be coloured red, clearly labelled, and be locked in the ON position.
- .6 Wiring:
 - .1 Install all wiring in metal raceways.
 - .2 Provide wiring suitable for fire alarm circuits.
 - .1 Class "A" wiring for initiating circuits.
 - .2 Class "A" wiring for signalling circuits.
 - .3 Provide fire rated cables for fire alarm circuits as required by applicable Codes and standards.
 - .4 Provide separate signalling circuits for horns and strobes.
 - .5 End-of-line resistors shall be furnished as required for mounting as directed by the manufacturer on Class B circuits.
 - .1 Install EOL resistors maximum 1800 mm above finished floor in interior spaces.
- .7 Install manual pull stations at 1200 mm above finished floor.
- .8 Install factory wire guards in gymnasium on pull stations, fire detectors, strobes and fire alarm horns.

3.02 Field Quality Control

- .1 The installing contractor shall provide a qualified project superintendent for the overall management and supervision of the work.
- .2 The project superintendent shall assure that adequate supervision is provided during all periods of installation of the fire alarm system. The project superintendent and all job site supervisors shall have a minimum of five years of continuous experience in the installation of fire alarm systems of similar scope and complexity.
- .3 Upon completion of the installation, the installing contractor shall test all alarm initiating devices, supervisory devices, control devices and notification devices for proper response and effectiveness. Operation of all annunciating devices including the FACP, printer and remote LCD panel shall be verified. Testing shall include thorough sound level measurements of audible notification devices. These tests shall be fully documented. All testing up to the point of conducting the final acceptance tests shall be recorded using a temporary printer. The permanent printer of the system, where such has been provided, shall not be installed prior to the final acceptance tests.
- .4 All smoke detectors shall be suitably protected against contamination up to the time of the final acceptance tests.
- .5 An itemized test report in accordance with latest edition of the Standard for Installation of Fire Alarm Systems CAN/ULC-S524, and the latest edition of the Standard for the Inspection and Testing of Fire Alarm Systems CAN/ULC-S536, and the latest edition of the Standard for the Verification of Fire Alarm Systems CAN/ULC-S537, shall be submitted to the Consultant. This report shall provide complete details of the testing completed for all devices as well as circuit testing parameters. Data shall be submitted indicating the sensitivity level of all system smoke detectors.
- .6 Following completion of a 100 per cent system functional test, the contractor shall perform a thorough acceptance test of the system at the direction of and to the satisfaction of the Owner and Consultant. This test shall not be carried out until at least 15 days after completion of all contractor's testing, modification and repairs following the original contractor's functional test and submittal of the functional testing documentation to the Consultant. The 15 day interval is also intended to be a system "burn-in" period. Any false activations of the system which occur within the burn-in period which are determined to be the result of a system fault shall result in the restart of the 15 day period.
- .7 In the event that the acceptance test of the system results in the need for system repair or modification, the contractor shall demonstrate the operability of the system to the full satisfaction of the Owner and Consultant following the completion of repairs or modification.

- .8 In the event that the AHJ requires a separate demonstration of the operability of the system for acceptance purposes, these additional tests shall be carried out by the Contractor without expense to the Owner.
- .9 The contractor shall conduct an independent quality assurance review of all developed "record" drawings to assure accuracy and completeness of these drawings. Any discrepancies shall be brought to the attention of the Consultant prior to construction start.
- .10 Only directly prior to verification, remove smoke detector protectors, and clean smoke detectors thoroughly.
- .11 Inspect and check each individual device in entire system for proper connection, supervision and function in accordance with CAN/ULC-S537. Identify detectors, manual pull stations and signal appliances not installed within requirements of CAN/ULC-S524 in remarks column of verification report
- .12 Obtain verification certificate and verification report from manufacturer showing each device checked, and that work has been carried out. Utilize standard verification forms similar to Canadian Fire Alarm Association (CFAA) forms.

3.03 Manufacturer Services

- .1 At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.

3.04 Adjusting

- .1 Contractor to verify programming of room names prior to fire alarm system programming, and allow for a revision to the fire alarm system programming should the Owner or AHJ wish to revise the room names.

3.05 Monitoring

- .1 Fire alarm control panel to be located as indicated. Coordinate third party CUL Listed monitoring with Owner.

3.06 Field Tests and Inspections

- .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. That all products of combustion (smoke) detectors have been properly calibrated and adjustments set correctly.
 - .3 That the representative's equipment has been installed in accordance with the manufacturer's recommendations.
 - .4 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.
- .2 Testing to be done in the presence of the local building inspector, and the local fire inspector.
- .3 The manufacturer(s) of the fire alarm shall make a complete inspection of all existing and new components installed for system(s), such as manual stations, horns, and annunciators and sprinkler and standpipe valves and smoke detectors to ensure the following:
 - .1 That the system is complete in accordance with Specifications.
 - .2 That the system is connected according to ULC requirements.
 - .3 That the system is connected in accordance with the manufacturer's recommendations.

- .4 That the regulations concerning the supervision of components have been adhered to (e.g. stations, detectors, supervised valves, bells), and are properly wired and supervised.
- .5 That all valves are properly connected and displayed correctly on each annunciator.
- .6 That any subsequent changes necessary to conform to the above will be carried out with technical advice supplied by the Manufacturer.
- .7 That all thermal detectors, smoke detectors and manual pull stations have been operated and are in good working order.
- .8 That all sprinkler system and standpipe system valves have been operated and are in good working order.
- .9 That all annunciators correctly pin-point the origin of any fire alarm.
- .10 That actual smoke concentration of sufficient density, have been applied to each smoke detector to cause the detector to be set off and that the sensitivity of each smoke detector has been set.
- .11 That all existing devices are in good working order. Include for replacing any defective/damaged devices at no extra cost to Owner.
- .12 That signal audibility is acceptable in all areas. Submit audibility readings for every Room.

3.07 Verification

- .1 Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.
- .2 All initial testing shall be in accordance with the latest issue of ULC-S537 Verification of Fire Alarm Systems standard.
- .3 A representative of the electrical contractor shall be present to participate and assist the manufacturer representative during the course of the verification. The electrical contractor shall make good any deficiencies discovered during the verification. All devices, new and existing, shall be verified. The electrical contractor shall provide one person for assistance with the verification.
- .4 The verification report shall be submitted for approval to the Consultant.
- .5 On completion of the inspection the manufacturer shall supply a certificate, together with detailed inspection record sheets showing location of each device and certifying the test results per unit, confirming that the system is installed, supervised and operate in accordance with Article "System Verification".

3.08 Audibility Test

- .1 Provide audibility test of signalling devices after other systems have been commissioned to verify operation at ambient sound levels.
- .2 Provide audibility test report to the Consultant.
- .3 Implement varied tone to suit audibility requirements.

3.09 Closeout Activities

- .1 The System Supplier shall schedule and present documented formalized instruction for the building owner, detailing the proper operation and maintenance of the installed System.
- .2 The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.
- .3 The instruction shall cover the schedule of maintenance required by ULC and any additional maintenance recommended by the system manufacturer.

- .4 Instruction shall be made available to the Local Municipal Fire Department if requested by the Local Authority Having Jurisdiction.
- .5 The contractor shall provide for a minimum of three training sessions of two hours in length. At least one of these training sessions shall be carried out for key personnel prior to the system being initially placed on-line for the beginning of the burn-in period.
- .6 Three bound copies which summarize the training instruction shall be submitted to the Owner for future reference.

End of Section

1 General

1.01 Section Includes

- .1 Fire Alarm Horns.
- .2 Fire Alarm Strobes.
- .3 Combination Horn/Strobes.

1.02 Related Requirements

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 28 46 21.11 – Addressable Fire Alarm Systems.

1.03 Unit Prices

- .1 Refer to Document 00 43 00.26.
- .2 Submit with Tender unit prices to provide the following:
 - .1 Provide fire alarm horn/strobe complete with wiring and conduit, based on 10 metre distance.
 - .2 Provide wire guard for any fire alarm device.

1.04 Extra Materials

- .1 Supply the following additional equipment as spare parts in a proper metal enclosure sized to accept the equipment as listed herein. Label the enclosure fire alarm spare parts. Enclosure shall be placed in the same room as the FACP.
 - .1 Supply three of each type of signalling device used on the project.
- .2 Provide (supply and install) an additional five of each of the following fire alarm devices as directed during construction. Turn over unused surplus in addition to those devices listed above:
 - .1 Fire alarm horns.
 - .2 Combination Horn/Strobes.

2 Products

2.01 General

- .1 All appliances which are supplied for the requirements of this specification shall be ULC Listed.
- .2 All appliances 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.

2.02 Horns

- .1 Vibrating horn: semi-flush mounted, 24 VDC, selectable 94 dBA or 98 dBA, suitable for installation in a standard electrical box.

- .2 Red enamel typical.

2.03 Horn-Strobes

- .1 Vibrating horn: semi-flush mounted, 24 VDC, selectable 94 dBA or 98 dBA, suitable for installation in a standard electrical box.
- .2 Red enamel typical.
- .3 Provide horn-strobes where shown on plans and drawings. Strobe output shall be determined as required by its specific location and application from a family of 15/75 cd, 30 cd, and 110 cd devices. Strobes shall provide a synchronized flash.
- .4 Strobes shall be 24 V DC and ULC listed.
- .5 Strobe circuits shall be coordinated with audible circuits such that activation of an audible circuit results in activation of the companion strobe circuit. The strobe circuits shall be capable of being arranged such that they continue to operate in the event that the audible circuits have been silenced and remain operating until the FACP has been reset. Strobe circuits should also be coordinated with the audible circuits such that they are zoned in the same manner as the audible circuits
- .6 All strobes and combination horn strobes shall be mounted such that the bottom of the device is mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

3 Execution

3.01 Installation

- .1 Installation to Section 28 46 21.11.

3.02 Testing and Inspection

- .1 Testing, and inspection to Section 28 46.21 11.

3.03 Verification

- .1 Verification to Section 28 46 21.11.

End of Section

1.1 Information Available for Review

- .1 The following documents are made available for review:
 - .1 Existing Drawings:
 - .1 Drawing Set, dated 1971
 - .1 Architectural, prepared by Snider Huget March
 - .1 A1 – A21
 - .2 Structural, prepared by Walter Fedy McCargar Hachborn Consulting Engineers
 - .1 S1 – S3
 - .3 Mechanical, prepared by Yuska, Wenzel and Sehl Ltd.
 - .1 M1 – M4
 - .4 Electrical, prepared by Walter Fedy McCargar Hachborn Consulting Engineers
 - .1 E1 – E5
 - .2 The accuracy of the information contained in the above listed documents has not been independently verified by the *Consultant*.

END OF SECTION

7266-RW-22 - Park Manor Pubic School Interior & Window Enhancements

Opening Date: February 11, 2022 9:00 PM

Closing Date: March 1, 2022 2:00 PM

Schedule of Prices

* Denotes a "MANDATORY" field

Do not enter \$0.00 dollars unless you are providing the line item at zero dollars to the Board.

Bid Price Form

Note: Cash Allowances included in BID PRICE.

Blackout Period Protocol is understood and will be adhered to.

HST is additional.

Line Item	Description	Unit of Measure	Quantity	Bid Price *	Total
1	Park Manor Public School – Interior & Window enhancements as per tender documents	Lump Sum	1		
Subtotal:					

Alternate Price

ALTERNATE PRICES:

The following are the prices for the alternative work listed hereunder.

Such alternative work and amounts are **NOT** included in our Bid Price.

Line Item	Description	Increase/Decrease *	Unit of Measure	Quantity	Price *	Total
1	Alternative Price #1 - Alternate tile TL1: – Stone Tile Porfirica, Colour: Aglo Matte, Size: 600 x 600 mm, 10mm thickness	Select A Value ▾	Lump Sum	1		

Summary Table

Bid Form	Amount
Bid Price Form	
HST (13%)	\$ 0.00
Total Contract Amount:	

Specifications

Bidder's Contact Information

Provide contact information for the following employees for this project.

If any of the contacts are to change within the duration of the contract the Board must be immediately notified and pre-approve the change(s).

Title	Name *	E-mail *	Cell Phone Number *	
Project Manager				*
Site Supervisor				*

Documents

It is your responsibility to ensure the uploaded file(s) is/are not defective or corrupted and are able to be opened and viewed by the Owner. If the attached file(s) cannot be opened or viewed, your Bid Submission may be rejected.

COVID REPSONSE

Submit a work plan that outlines how the company plans to address COVID-19, including implementing workplace strategies that include, but are not limited to, social distancing, personal hygiene recommendations, and other relevant recommendations made by the government of Ontario, the government of Canada, the local municipal government, and their respective ministries, agencies, and departments, in respect of the employees and other personnel of the successful bidder, their subcontractors and suppliers, as well as the employees and other personnel of the Board, the Board's Consultant, and the general public.

- WSIB * (mandatory)
- Covid Response * (mandatory)

BONDING UPLOAD SECTION

Refer to the Bonding Requirements Section of the Terms and Conditions.

- Digital Bid Bond & Agreement to Bond * (mandatory)

Addenda, Terms and Conditions

I/We have read and understand this Bid Solicitation document, and agree to perform the Work required in accordance with this Bid Solicitation document, including all addenda, at the price(s) detailed in the Bid.

I/We confirm that:

1. The person named in this Bid is authorized to sign and electronically submit this Bid through the Bidding System.
2. I/We meet all mandatory requirements of the Bid Solicitation document.
3. The bid will remain open for a specified acceptance period after the Closing Time. The Board may, at any time within this period, accept the Bid whether or not any other Bid has previously been accepted.
4. All prices provided in the Bid will remain fixed and firm for the duration of the term of the agreement, unless specified otherwise.
5. All prices provided in my/our Bid are in Canadian funds and include all charges of every kind attributable to the Work. Harmonized Sales Tax will be extra and not shown, unless specified otherwise.
6. To the best of my/our knowledge and belief:
 - a) the information provided in the Bid is correct; and
 - b) the Bid is made without any comparison of figures or arrangement with any other individual, corporation or person submitting a Bid for the same Work and is in all respects fair and without collusion or fraud.
7. I/We comply with the all applicable Board policies, provincial, and federal laws, and are aware of the Board's "Principles of Business Conduct" and will comply.
8. I/We agree and understand that the recommendation to award the Work may be subject to the approval from the Board as well as availability of funds.
9. I/We agree to be bound by the terms and conditions of the Bid Solicitation document and submit this Bid on behalf of the Bidder.

I have the authority to bind the Bidder.

The Bidder/Proponent is to declare any actual, potential or perceived conflict of interest that could arise from submitting the Bid/Proposal.

Do you have a potential conflict of interest?

Yes **No**

The Bidder acknowledges and agrees that the addendum/addenda below form part of the Bid Solicitation Document.

Please check the box in the column "**I have reviewed this addendum**" below to acknowledge each of the addenda.

File Name	I have reviewed the below addendum and attachments (if applicable)	Pages
There have not been any addenda issued for this bid.		