



**Waterloo Region
District School Board**

REQUEST FOR TENDER

25-7748-RFT

St. Andrew's Public School 3rd Floor Classroom Refinishing

ISSUE DATE: May 2nd, 2025

**ELECTRONIC SUBMISSIONS will be received by the Bidding System no later than
2:00 p.m. local time, on May 21, 2025.**

00 01 00 Consultant/Professional Seals

- 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 Architect



1.1.2 Structural



FOR STRUCTURAL REVIEW LETTER ONLY

1.1.3 Mechanical



1.1.4 Electrical ED-22-405



END OF SECTION

Document Responsibility

1.1 Document Responsibility

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

END OF SECTION

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DR - indicates entity responsible for preparation of listed documents (see Section 00 01 05)

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00 01 00 Consultant/Professional Seals	O	1	May 2, 2025
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00 21 13 Instructions to Bidders	O	12	May 2, 2025
00 21 14 General Contractors and Subcontractors	O	2	May 2, 2025
00 21 15 Scope of Work	O	2	May 2, 2025
00 31 00 Information Available for Review	O	1	May 2, 2025
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01 14 00 Work Restrictions.....	O	2	May 2, 2025
01 19 00 Specifications and Documents.....	O	2	May 2, 2025
01 21 00 Allowances	O	3	May 2, 2025
01 31 00 Project Managing And Coordination.....	O	6	May 2, 2025
01 32 00 Construction Progress Documentation.....	O	3	May 2, 2025
01 33 00 Submittal Procedures.....	O	5	May 2, 2025
01 35 17 Fire Safety Procedures	O	8	May 2, 2025
01 35 17A Appendix - Contractor Hot Work Permit	O	1	May 2, 2025
01 35 23 Health And Safety	O	5	May 2, 2025
01 35 43 Hazardous Materials	O	4	May 2, 2025
01 35 43A Appendix - Asbestos Audit Report	O	1	May 2, 2025
Project Specific Designated Substance & Hazardous Material Assessment Report	O	55	January 29, 2025
01 35 34B Appendix - Lead Report	O	1	May 2, 2025
Certificate of Analysis (Guideline Evaluation).....	O	5	April 12, 2025
EACC Lead Guideline For Construction, Renovation, Maintenance or Repair.....	O	52	October 2014
01 42 00 References	O	5	May 2, 2025
01 45 00 Quality Control	O	7	May 2, 2025
01 51 00 Temporary Utilities	O	5	May 2, 2025
01 53 00 Temporary Construction Facilities.....	O	6	May 2, 2025
01 54 00 Materials and Equipment	O	3	May 2, 2025
01 61 00 Product Requirements	O	5	May 2, 2025
01 70 00 Examination and Preparation.....	O	3	May 2, 2025
01 73 30 Execution and Cutting and Patching	O	4	May 2, 2025
01 74 00 Cleaning and Waste Management.....	O	4	May 2, 2025
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01 79 00 Demonstration and Training	O	3	May 2, 2025
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02 41 16 Demolition	A	4	May 2, 2025
DIVISION 06 - WOOD, PLASTIC, AND COMPOSITES			
06 10 53 Rough Carpentry	A	3	May 2, 2025
06 40 00 Architectural Woodwork	A	8	May 2, 2025
DIVISION 07 - THERMAL AND MOISTURE PROTECTION			
07 21 00 Thermal Insulation	A	2	May 2, 2025
07 84 00 Joint Firestopping and Smoke Seals	A	7	May 2, 2025
07 92 00 Joint Sealants	A	8	May 2, 2025
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09 22 00 Metal Supports for Gypsum Board	A	7	May 2, 2025
09 29 00 Gypsum Board	A	11	May 2, 2025
09 51 23 Acoustical Tile Ceiling Systems	A	5	May 2, 2025
09 65 13 Resilient Base and Accessories	A	5	May 2, 2025
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20 05 10 Mechanical Work General Instructions	M	20	May 2, 2025
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20 05 33 Heat Tracing for Mechanical Piping	M	3	May 2, 2025
20 05 48.13 Vibration Controls for Mechanical Systems	M	7	May 2, 2025
20 05 53 Identification for Mechanical Piping and Equipment	M	4	May 2, 2025
20 05 93 Testing, Adjusting, and Balancing for Mechanical Systems	M	5	May 2, 2025
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23 81 29 Variable Refrigerant Flow HVAC Systems	M	7	May 2, 2025
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26 05 00 Common Work Results for Electrical.....	E	20	May 2, 2025
26 05 05 Selective Demolition for Electrical	E	3	May 2, 2025
26 05 19 Low-Voltage Electrical Power Conductors and Cables..	E	8	May 2, 2025
26 05 23 Control-Voltage Electrical Power Cables.....	E	3	May 2, 2025
26 05 26 Grounding and Bonding for Electrical Systems	E	5	May 2, 2025
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26 05 44.13 Firestopping for Electrical Systems.....	E	9	May 2, 2025
26 05 47 Outdoor Pedestals for Electrical Systems	E	3	May 2, 2025
26 05 53 Identification for Electrical Systems.....	E	6	May 2, 2025
26 05 73.16 Coordination Studies	E	5	May 2, 2025
26 05 73.19 Arc-Flash Hazard Analysis	E	6	May 2, 2025
26 05 83 Wiring Connections.....	E	5	May 2, 2025
26 06 50.19 Lighting Control Preset Schedule	E	3	May 2, 2025
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26 08 50 Commissioning of Lighting	E	2	May 2, 2025
26 09 23 Lighting Control Devices	E	8	May 2, 2025
26 24 16 Panelboards	E	8	May 2, 2025
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27 15 01.19 Fire Alarm Communications Conductors and Cables...	E	3	May 2, 2025
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END OF SECTION

DIVISION 00 – BIDDING AND CONTRACT DOCUMENTS

00 21 13 Instructions to Bidders

1. Designated Representative

To contact the Board or ask questions in relation to this Procurement, bidders must initiate the communication electronically through the Bidding System. The Board will not accept any respondent's communications by any other means, except as specifically stated in the Procurement. Bidders must not communicate in any manner with anyone other than the Designated Representative.

For the purposes of this procurement process, the Designated Representative will be:

Procurement Lead: Ardith Inapan
Title: Buyer
Waterloo Region District School Board
Email: ardith_inapan@wrdsb.ca

2. Consultant

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

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

The Consultant 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.

3. 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 or employees, unless initiated by the Board's Designated Representative, noted above.

4. Communication and Question Protocol

Bidders and their representatives are NOT permitted to contact WRDSB Project Managers/Leads, agents of the Board; any member of the Board's governing body (such as Board of Trustees, or advisors); any employee, consultant, or agent of the Board's Clients, other than the Designated Representative listed above. Any attempt by a Bidder to bypass or influence the procurement process may result in disqualification of the Bidder and the rejection of the Bidder's 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 Designated Representative, noted above in writing, shall not be relied upon.

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 Procurement Document.

All requests for information, instructions, or clarifications shall be through the Bidding System by clicking on the "Submit a Question" button found within the bid detail of the specified Procurement. Addenda will be issued accordingly.

It is the responsibility of the Bidder to seek clarification of any matter that they consider unclear before submitting their application. The Board is not responsible for any misunderstanding of the Procurement documents on the part of the Bidder.

5. Doing Business with 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 122 school locations and serving approximately 64,000 students in the Region of Waterloo.

Bid opportunities above \$10,001 CAD will be solicited through the electronic bidding system [bids&tenders](#) or the Board may also utilize Supplier roster lists awarded through a competitive process, participate in cooperative procurements with various public entities, or buying groups. These may include, but are not limited to, Ontario Education Collaborative Marketspace, Supply Ontario, and other Cooperative Group(s).

WRDSB competitive opportunities are posted on the Electronic Bidding System, [bids&tenders/wrdsb](#).

The WRDSB only accept electronic Bid Submissions submitted through the Electronic Bidding System, [bids&tenders/wrdsb](#)

Bid opportunities may be posted as Public or by Invitation and are based on dollar thresholds outlined in Administration Procedure 4570 PROCUREMENT. Click [here](#) to access the Board's Administrative Procedures, Section 4000 – Business Services.

6. Anticipated Project Schedule

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 of Tender	May 02, 2025
Non-Mandatory Pre-Bid Site Examination	Date: Tuesday, May 6, 2025 Time: 3:00pm 65 Victoria Avenue, Cambridge, ON Meeting Area: Outside Main Office
Deadline for Questions	May 19, 2025
Closing Date and Time	May 21, 2025, 2:00 pm local time
Anticipated Contract Start / Work begins	Jun 30, 2025
Substantial Completion Date	Aug 22, 2025
Ready for Takeover	Aug 28, 2025
Deemed Complete Date	Oct 31, 2025

7. Pre-Bid Site Examination

Bidders are strongly encouraged to attend the non-mandatory pre-bid site examination and sign the attendance sheet. Date, time and location are provided above in the Anticipated Project Schedule. The Board may not provide another opportunity to visit

Bidders shall attend the site meeting at their own risk and hold the Board harmless for any issues or damages arising out of their attendance of the site meeting.

The Owner will not consider any claims for additional payments during the execution of the Work for extra work or difficulties encountered resulting from conditions which were either visible or could be reasonably inferred from an examination of the Place of the Work and the available project information prior to the submission of Bids.

Bidders are encouraged to bring their own measuring tape, camera, or other portable tools as required to the site meeting. Bidders are solely responsible for making their own assessment of the site.

8. Secondary Site Examinations

Bidder may request a secondary site examination visit through the Bidding System by clicking on the "Submit a Question" button found within the bid details page of that Procurement. Include the contact's name and email of the person who will visit the site.

Bidders shall attend the secondary site examination visit at their own risk and hold the Board harmless for any issues or damages arising out of their attendance of the site meeting.

Bidders not in attendance of a Mandatory Pre-Bid Site Examination meeting will not be provided an opportunity to a secondary site examination visit.

Bidders must adhere to all communication protocols, as describe in Section 1.0, Sub Section 4. Communication Protocol.

The Owner will not consider any claims for additional payments during the execution of the Work for extra work or difficulties encountered resulting from conditions which were either visible or could be reasonably inferred from an examination of the Place of the Work and the available project information prior to the submission of Bids.

Bidders are encouraged to bring their own measuring tape, camera, or other portable tools as required to the site meeting. Bidders are solely responsible for making their own assessment of the site.

9. Examination of Bid Documents and Work and Submitting Questions

- i. Bidders are required to fully acquaint themselves with the Procurement documents; fully inform themselves of all conditions, limitations and requirements involved in the Procurement; and obtain all information that may be necessary to complete those requirements before submitting a Bid.
- ii. Submission of a Bid shall be considered conclusive evidence that the Bidder has satisfied itself as to the requirements of this Procurement.
- iii. In the event a Bidder discovers any errors, discrepancies, inconsistencies, or omissions or requires clarification within this Procurement, they are to submit their observations and/or questions through bids&tenders by clicking on the "Submit a Question" button found within the bid detail of the specified Procurement by the Deadline for Questions specified in this paragraph.
- iv. Bidders are strongly encouraged to ask clear and concise question(s) or statements citing the relevant section of the Bid Solicitation Document. The Board cannot guarantee a response to questions received by the Board after the Deadline for Questions.
- v. The Board has endeavored 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.
- vi. 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 Designated Representative prior to the Deadline for Responses 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.

- vii. Written responses or clarifications to issues of substance will be shared with all Bidders in the form of an Addendum.

10. Electronic Bid Submission Only / Electronic Bidding System

Competitive opportunities including Requests of Prequalification (RFPQ) are posted on the Electronic Bidding System, [bids&tenders/wrdsb](#).

The Bidder must submit their bid through the Bidding System only. Any other form of submittal will not be considered. It is the Bidder's responsibility to read the Procurement documents thoroughly including all attachments and addenda, if any, as these contain information that is highly pertinent to this Procurement and to clarify any details with the Designated Representative prior to their submission. To be considered, Bidders must respond to this Procurement.

- i. In order to submit a bid, bidders must be registered with [bids&tenders](#). The sole onus is on the bidder to have the most current correct information set-up in bids&tenders including but not limited to plan taker contact information, categories, and agency.
- ii. All Bids shall be submitted through [bids&tenders](#) only. The onus is on the Bidder to ensure all requirements of the Bid Solicitations are submitted.
- iii. If the bidder encounters technical issues, the onus is on the bidder to have this resolved prior to the closing date and time by contacting support@bidsandtenders.ca
- iv. Bidder shall have a "Vendor account" in the Bidding System and shall ensure the account is created with the Bidders full legal company name and be registered as a "plan taker" for this bid solicitation. Only the plan takers will have access to download bid documents, receive addenda email notifications, download addenda and to submit their bid electronically through the Bidding System.
- v. The onus is on the Bidder to ensure that the Bid is received 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.
- vi. Bidders shall allow sufficient time to upload their Bid submission including all requirements as stated in this Procurement 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
- vii. All prices including provisional/supplementary pricing, if requested, shall be submitted in the Schedule of Prices forms available through the Bidding System.

- viii. The Owner reserves the right to accept or reject any or all provisional bid prices submitted, and such prices shall remain in effect for the duration of the Contract. Failure to submit provisional prices where required may result in the Bid being declared non-compliant.
- ix. Bids submitted by fax or paper copy, or any other format will not be accepted.
- x. The Bidding System will not accept Bids after the Closing Time as determined by the Bidding System's web clock.
- xi. 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.
- xii. Upon submitting 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
- xiii. There will be no public opening for this Bid.
- xiv. If a Bid is a joint submission of two (2) or more firms, a single Bid is to be coordinated and submitted by the lead Bidder with the required information. If two or more parties submitted a joint response to this Bid Solicitation, they shall decide between them who is to be the Bidder, without any involvement of the Board.
- xv. Your online Bid submission shall be taken as your statement that you understand the requirements and agree to comply with the requirements as well as terms and conditions stated in this Bid Solicitation document, including Board's Standard Terms and Conditions. Your Bid submission through the Bidding System confirms that you have checked and confirmed your pricing and by submitting the Bid online, you agree that you have not omitted any items from your Bid.
- xvi. For construction projects with Bids above \$200,000 the Successful Bidder will be required to execute a "Canadian Standard Form of Construction Contract to a Stipulated Sum" (CCDC 2 - 2020 including amendments thereto as set out in this Procurement.

11. Bid Prices

- i. The amounts stipulated on the Schedule of Prices are intended to cover the cost of the complete Work as described in this Bid Solicitation Document.

- ii. All prices shall be in Canadian Funds, Free On Board (FOB) Destination, Freight Prepaid (Board locations).
- iii. Exclusive of the HST, or other similar taxes.
- iv. Unit pricing shall be exclusive of Harmonized Sales Tax (HST), but shall include all applicable costs including but not limited to overhead, material, labour, travel, fuel, fuel surcharge, equipment, disbursements, expenses, customs, charges, freight, shipping and handling costs, and all other charges of every kind attributable to the services, equipment or goods provided.
- v. The person submitting the Bid on behalf of the Bidder must have authority to bind the Bidder.
- vi. Quantities may be estimated and subject to change, and therefore the Board, at its discretion, may purchase more or less of the commodity based on the unit price bid.
- vii. All information required on the forms shall be completed in full including references and Sub-contractors that it proposes to use for Work described. Changes made to the list of nominated Sub-contractors after the closing of the Bid, must have prior written approval of the Board's Single Point of Contact.
- viii. All price(s) submitted shall be a reasonable price for each particular item as determined by the Board and under no condition will an unbalanced Bid be considered. Submissions containing prices which appear to be so unbalanced as to likely affect the interests of the Board adversely will be clarified and may be rejected.
- ix. Unit prices and/or optional pricing, if any will set the foundation for any approved increases or decreases in Work. The unit prices must remain fixed and firm for the term of the Contract, unless otherwise specified in this Bid Solicitation document.
- x. Provisional or Optional Pricing may or may not be required for completion of the Work called for under the Contract. The Board will decide necessity of these items and quantities thereon based on the unit prices(s) included in their Bid. If Optional items are not purchased, or quantities are less than estimated, no adjustment or compensation will be awarded to the Bidder by the Board. Optional pricing is not used for comparison of Bids for award purpose.

12. References - Not Applicable

13. Addenda

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

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.

Prior to bid closing any discrepancies, omissions, questions, or clarifications regarding the procurement documents must be sent immediately through the Bidding System by clicking on the "Submit a Question" button found within the bid details page of that opportunity no later than the deadline noted in the Anticipated Project Schedule. Those that are deemed pertinent to the Bid Solicitation Document will be addressed in the form of an Addendum.

It is understood and acknowledged that while the Bid Solicitation document includes specific requirements, a complete review and recommendation is required. Minor items or details not herein specified, but obviously required for the Work shall be provided as if specified in conformance with modern practices. Any omissions or errors or misrepresentation of these requirements and specifications within the Bid Solicitation document shall not relieve the Bidder of the responsibility of providing the services or products as aforesaid.

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

Where an Addendum is issued after a Bid has been submitted, the Bidding System will automatically withdraw the submitted Bid. The Bid 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 make any required adjustments to their submission, acknowledge all Addenda and ensure the Bid has been received by the Bidding System. Bidders should check the Bidding System for Addenda up until the Bid Closing Date and Time.

Addenda cannot be acknowledged after the Closing Date and Time.

14. Edit and Withdrawal of Bid Submission

- i. A Bidder who has submitted a bid may edit or withdraw its bid at any point up to the Closing Date and Time.
- ii. Any edits to a bid submission will cause the submission to automatically be withdrawn. The bid submission must be re-submitted to be accepted.
- iii. The Bidder is solely responsible for ensuring that its re-submission is received prior to Closing Date and Time. The closing time shall be determined by the web clock within the Bidding System. After such time, requests to withdraw Bid will not be considered.

15. Irrevocable Period

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

16. Tie Bids

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

17. Bid Irregularities

Bids with one or more of the following may be declared informal and/or disqualified and/or non-compliant:

- i. Bids that do not comply strictly with all terms and conditions of the Bid Solicitation Document.
- ii. Bids that are incomplete, conditional, qualified, or obscure.
- iii. Bids that are based upon an unreasonable period of time for completion of the Work.
- iv. Bids received from Bidders involved in Claims with either of the Board or banned or on probation with the Board.
- v. Bids received from any Bidder deemed to be unskilled or experienced in the work contemplated, or those who have defaulted on, or failed to satisfactorily complete other similar work in the past.
- vi. Bids submitted by Bidders that are not prequalified, where applicable.

18. Bid Review

- i. All Bids received on or before the Closing Time will be reviewed for compliance based on this Bid Solicitation document. Non-compliant Bids will be rejected. Bids not meeting any of the mandatory requirements included in this Bid Solicitation document will be disqualified. Bidders may be contacted to clarify their submissions.
- ii. Should there be any error in extensions, additions or computations, the Board shall be entitled to correct such errors based upon the unit prices supplied, and the corrected total shall be considered as representing the intention of the Bidder and shall be used as the basis for comparison of Bids.
- iii. It is the Bidder's responsibility to satisfy the Board that they can comply with the requirements contained within this Bid Solicitation document and that they possess 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 of the Board.
- iv. The Board also reserves the right to examine Bidder's facilities, equipment and visit the subcontractors or sub-consultants proposed and/or Bidder's existing and past clients. The award decision may be revised based on the above.
- v. The Board will not be responsible for travel costs 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.

- vi. The Board may, in its 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 reserves 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 their Bid.
- vii. The Board may request a meeting with Bidders.

19. Post-Award Meeting

A post-award meeting may be held consisting of the successful Contractor, and their key personnel assigned to the contract, the Board's Project Manager/Lead and if applicable the Architect/Consultant, to discuss the program and exchange information before the contract commences. This meeting will be at the sole expense of the Bidder and shall be considered part of the contract. If applicable, the meeting date will be scheduled after the Award.

20. Intent to Award

Bidders are advised not to make any business decisions, assignments, or any sub-contract for the execution of the Work, before receiving a Purchase Order from the Board.

- i. Subject to the reserved rights of the Board and availability of funds, the lowest compliant Bid will be recommended for award.
- ii. There shall be no obligation on the Board as a result of seeking Bids or conducting the procurement process and the Board reserves the right to pursue other Bidders, cancel the Bid Solicitation, issue a revised request, or to pursue any other course of action which would aid in meeting their needs.
- iii. If instructed, within twenty-four (24) hours, excluding hours occurring during a Saturday, Sunday, or a legal holiday, of receiving a request or intent to award from the Board, the Bidder (the "Recommended Bidder") shall provide a list of all Subcontractors/Subconsultants that it proposes to use for all Work described in this Procurement including the Company Name, Sub Trade Category and if applicable, related Divisions.
- iv. Within **seven (7) calendar days** of receiving a request or intent to award from the Board, the Bidder (the "Recommended Bidder") shall provide the following mandatory requirements:

- a. Insurance certificate with coverage specified in the Bid Solicitation Document.
 - b. WSIB clearance certificate valid on the date of award or an exemption letter (if applicable and requested).
 - c. Non-Disclosure Agreement (NDA) duly signed by the authorized signatory (to be renewed annually). The Board will provide this form.
 - d. Bonding Requirements, if applicable, as specified in the Bid Solicitation Document.
 - e. An executed Board issued Form of Agreement, if applicable, and duly signed by the authorized signatory.
 - f. Any other submittal specified in the Bid Solicitation Document or in the intent to award, as a requirement of award.
 - g. For construction projects above \$200,000 the Successful Bidder will be required to execute a "Canadian Standard Form of Construction Contract to a Stipulated Sum" (CCDC 2 – 2020) including amendments thereto as set out in this Procurement.
- v. The documents listed below will be incorporated as deemed necessary by the Board, into the Contract with the 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:
- a. Board approved change order(s) or Contract / Agreement / CCDC 2 -2020 amendment(s)
 - b. Purchase Order(s), Contract(s) Agreement(s) / CCDC 2 -2020 executed with the Bidder including exhibits
 - c. Bid Solicitation document issued by the Board, including addenda, if applicable
 - d. Bid submitted by the Bidder

21. Post Award

In addition to all of the Board's other remedies, if a recommended Bidder fails to satisfy the requirements and/or execute the Form of Agreement or any other applicable conditions within seven (7) calendar 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.

The Bidder may protest within the five (5) day Notice of Intent to Award, after that, the protest will not be reviewed or accepted.

22. Award Posting Notification

For procurements valued at \$121,200 or more, and in accordance with the Broader Public Sector Procurement Directive, once the Board is satisfied that all requirements

are met, the project award notification will be posted in the same manner as the procurement documents were posted. The notification will be posted after the purchase order and/or agreement between the successful bidder and the Board has been issued/executed. The award notification will list the name of the successful bidder, agreement start and end dates, and any extension options.

END OF SECTION

00 21 14 – General Contractors and Subcontractors

1.0 General Contractors

- 1.1 Only invited prequalified General Contractors, as a result of the award of a competitive prequalification process, #23-7430-RFPQ, may submit a bid for this opportunity. Invitations are based on awarded Project Size Categories. Roster approved GCs can only bid on the project size categories based on the award.
- 1.2 A Site Supervisor and Project Manager, assigned to manage and supervise the Work, must be named in the Bidder's Contact Information Specification section through the electronic Bidding System only and include resumes. Personnel will be subject to approval by the Board and cannot be changed without prior written approval from the Board.

2.0 Subcontractors/Subconsultants

- 2.1. Refer to specification sections for products, suppliers and installers that will be required.
- 2.2. The Subcontractor/Subconsultant list is not required at time of bid submission.
- 2.3. The Subcontractor/Subconsultant list is mandatory after the bid closing date from the Recommended Bidder within twenty-four (24) hours of receiving a request or intent to award from the Board.
- 2.4. The Bidder (the "Recommended Bidder") shall provide a listing in a Board approved formatted list of Subcontractor/Subconsultant that it proposes to use for all Work described in this Procurement including the specification sections, as per the following:
 - 2.5.1 Bidders shall select experienced and qualified Subcontractor/Subconsultant or Suppliers in their field to perform or supply an item of Work indicated in this Procurement.
 - 2.5.2 The Bidder shall be fully aware of the capability of each Subcontractor/Subconsultant and/or Supplier included in its bid, including but not limited to technical ability, financial stability and ability to maintain the proposed construction schedule.
 - 2.5.3 The Owner reserves the right to reject any nominated Subcontractor/Subconsultant or supplier, based on the following but not limited to unsatisfactory past performance, suspended/removed from doing business with the Board and/or outstanding/unresolved corrective action notice issued by the Owner to the Subcontractor/Subconsultant within the last three (3) years.
 - 2.5.4 The Owner reserves the right to obtain information from the Bidder and from third parties respecting the qualifications and experience of the Bidder's nominated list of Subcontractor/Subconsultant for such item of the Work.

- 2.5.5 The Board reserves the right to examine Bidder's facilities, equipment and visit the Subcontractor/Subconsultant's proposed.
- 2.5.6 The substitution of any Subcontractor/Subconsultant and/or Suppliers after the list is submitted will not be accepted unless a valid reason is given in writing to and approved by the Owner, whose approval may be arbitrarily withheld.
- 2.5.7 Where a bidder lists "own forces" in place of a Subcontractor/Subconsultant, the bidder shall carry out such item of the Work with its own forces.
- 2.5.8 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.

END OF SECTION

00 21 15 – Scope of Work

Architectural Work:

3rd Floor:

- Remove existing acoustic tile ceiling in classrooms and corridors and replace in new location as required to accommodate new mechanical ducting;
- Scrape off existing flaking lead based paint at Roof drywall;
- Provide GWB coves at doors and window locations;
- Demolition existing millwork shelving and replace;
- Remove and replace whiteboards where necessary, remove and replace whiteboard tray as required;
- Remove wall trim at ceiling;
- Rehabilitate remaining existing wood trim and wainscoting;
- Paint all walls, trim and GWB coves in classrooms and corridors;
- Sand and refinish wood floors;
- Replace AVT in classrooms where present with sheet vinyl; P
- Providenotice mounting boardat each classroom entrance;
- Provide and install window blinds as required;
- Provide enclosure extension to Corridor electrical riser;

Mechanical Work:

3rd Floor:

- Provide new ductwork at 3rd Floor ceiling along with new roof top mechanical units;
- Provide new sprinkler heads at locations coordinated with new ceilings;

Electrical Work:

Basement:

- Provide new wiring as required for extra loading for new equipment at 3rd Floor:

3rd Floor:

- Provide new light fixtures throughout in all classrooms, rooms and corridors;

- Provide new switches, controls, and ceiling devices in support of new lights and mechanical equipment;
- Provide new electrical outlets and raceways in all classrooms as required;

Structural Work:

3rd Floor:

- Provide structural support as required at new mechanical units;
- Provide reinforcement at roof penetrations as required;

Audiovisual and IT Systems:

- Install new ceiling mounted projectors and Sound Fields in all 3rd Floor Classrooms;
- Provide for new conduit and wiring from devices to teacher desk locations as required;

END OF SECTION

1.1 Information Available for Review

- .1 The following documents are made available for review:
 - .1 Hazardous materials/designated substances report(s):
 - .1 "Project-Specific Designated Substance & Hazardous Materials Assessment, St Andrew's Senior Public School 65 Victoria Avenue, Cambridge, Ontario", dated January 29, 2025, prepared by Safetech Environmental Ltd.
 - .2 "Certificate of Analysis (Guideline Evaluation)", dated April 12, 2025, prepared by ALS Canada Ltd.
 - .3 "EACC Lead Guideline For Construction, Renovation, Maintenance or Repair", dated October 2014, prepared by Environmental Abatement Council of Canada.
- .2 The accuracy of the information contained in the above listed documents has not been independently verified by the *Consultant*.

END OF SECTION

Instructions:

- Sample:**

[illegible]

Project Name: _____

School / Location: _____

Date: _____

[illegible]

00 56 13 – Definitions Stipulated Price

1.1. Definitions Declaration

- .1 CCDC 2-2020 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 2-2020

- .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 usable 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 Ready for Takeover: *Ready-for-Takeover* shall have been attained when the conditions set out in GC12.1, SC 55.1 , 12.1.1
- .16 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.
- .17 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.
- .18 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.
- .19 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.
- .20 Tender: Refer to definition of Bid.
- .21 Unit Price: The amount payable for a single unit of Work as stated in a Schedule of Prices.
- .22 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.
- .23 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.
- .24 Provide: To Supply and Install
- .25 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.
- .26 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

00 72 13 – Standard Terms and Conditions

1. **Applicable Terms and Conditions (Supplier)**

None of the standard or other terms, conditions, or policies of the Bidder, whether published or otherwise shall be of any effect unless accepted by the Board in writing. This includes, without limitations, terms in publications, web-site, sales invoice, delivery document as well as those commonly applied by the Bidder. Board's acceptance of goods, equipment or service, acknowledgement thereon or paying invoices shall not imply acceptance of such terms, conditions, or provisions.

2. **Bankruptcy**

If, during the term of the Contract, the Supplier makes an assignment for the benefit of creditors, or becomes bankrupt or insolvent, or makes a proposal to its creditors, the Contract with the Supplier shall immediately be terminated, and the Board shall be entitled to enter into an agreement with another party without the consent of the Supplier.

3. **Basis of Award (Price factor)**

Bidders shall be deemed to have included all costs related to the Work in the Total Price as provided in their Bid, except for items clearly identified as provisional in the Bid Solicitation document. In no case shall the invoicing for the entire Work performed exceed the Total Price, unless additional Work is ordered by the Board in writing. The unit prices as well as provisional pricing shall be used to invoice the additional or provisional work, as required by the Board. For the purpose of award, the Total Price will be considered as representing the intention of the Bidders and will be used as the basis for comparison of Bids for the price factor.

4. **Bonding Requirements**

Bonding is only required if the project is equal to or greater than \$200,000.00.

Note: The Bidding System has flagged these fields as mandatory. If your bid is less than \$200,000.00, you may upload a pdf document stating: Not Applicable.

i. **Bid Amount**

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

ii. **Bid Deposit Bond & Agreement to Bond**

Bid submissions 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 of 10% of the total base bid (inclusive of HST) 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.

Bid Submissions must be accompanied by an Agreement to Bond in the form of a digital Bond in an electronically verifiable and enforceable (e-Bond), completed and executed by the Bidder's Surety, assuring the successful Supplier shall provide for a Performance Bond for 50% of the total Contract Price, and a Labour and Material Payment Bond for 50% of the total Contract Price.

Bidders shall upload their digital Bid Deposit Bond and Agreement to Bond separately to the Bidding System, in the bid submission files labeled "Bid Deposit Bond" & "Agreement to Bond". If both Bonds are within one (1) document, upload it in both files. All instructions and details for accessing authentication shall be included with the digital Bonds uploaded in the Bidding System. Do not include and/or upload Performance Bond and Labour and Materials Bond in this section.

Bids that do not contain the bid deposit(s) in the required amount 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 but not necessarily limited to: signed agreement, satisfactory security, insurance certificate, appropriate Workplace Safety and Insurance Board letter of clearance certificate) 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 seven (7) calendar days of written notification of the award of the contract.

iii. Performance and Labour & Materials Bonds

For bid amounts where bonding is required, inclusive of all taxes, the Supplier 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 Price 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 and extends protection to Sub-contractors, Suppliers, and any other persons supplying labour or materials to the Project. For more information, contact your surety company or visit the Surety Association of Canada website.

If the Supplier fails to provide a performance bond and/or labour and materials 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 Supplier may be subject to future bidding constraints by the Board.

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

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

Bonds must be submitted through the Bidding System within seven (7) calendar days of receiving the Intent to Award.

5. Business Code of Conduct for Board Employees

The Board will not knowingly purchase goods and/or services from Suppliers who operate 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 Supplier, including the cancellation of the contract.

The Board expects that all employees and Suppliers act within the parameters of the in Administration Procedure 4360 PRINCIPLES OF BUSINESS CONDUCT FOR BOARD EMPLOYEES. Click [here](#) to access the Board's Administrative Procedures, Section 4000 – Business Services.

6. Code of Conduct for Suppliers

These Guidelines cover any contractor, supplier, consultant, business, firm, company or individual doing work, providing a service or delivering goods on any Waterloo Region District School Board property, as well as the Supplier's employees, sub-contractors, agents, consultants, and others on site in connection with the Supplier's work or at the Supplier's express or implied invitation.

- i. **Courtesy and Respect:** all Suppliers and their employees must conduct themselves in a manner that is lawful, courteous, respectful, businesslike, and free of bias to the Board, its officer, employees, students, guests, or visitors.
- ii. **Language and Behavior:** Suppliers and their employees cannot engage in behavior that is rude, threatening, or offensive. Use of profane or insulting language is prohibited. Harassment of any type, including sexual harassment is strictly prohibited. Abusive, derogatory, obscene or improper language, gestures, remarks, whistling, cat calls or other disrespectful behavior cannot be tolerated.

- Rough housing, fighting, fisticuffs, physical threats, destruction of property, vandalism, littering, or physical abuse of anyone on WRDSB property are not permitted under any circumstance.
- iii. **No Weapons, Alcohol, or Drugs:** The use, possession, distribution, or sale of any weapon, alcohol, illegal drug, or controlled dangerous substance by any Supplier or Supplier's employee is prohibited. Offenders will be removed from WRDSB property and/or reported to the local Police Department.
 - iv. **Smoking:** Suppliers and their employees are not permitted to smoke on WRDSB property, in or near any buildings.
 - v. **Fraternization:** Suppliers and their employees may not fraternize or socialize with WRDSB students or employees.
 - vi. **Appearance:** Suppliers and their employees are required to wear appropriate work wear, hard hats and safety footwear, as the case may be, while on WRDSB property. Articles of clothing must be neat and tidy in appearance, and cannot display offensive or inappropriate language, symbols or graphics. WRDSB has the right to decide if such clothing is inappropriate.
 - vii. **Vehicles and Driving on Board Property:** Vehicles must clearly indicate the Supplier's company name, identifier number and telephone number. It must be readable from 8 meters (25 feet) away. Vehicles including movable Equipment/Machinery must not enter, leave or drive on Board premises during nutritional breaks, before and after school hours, or anytime there are students or staff outside of the building.
 - viii. **Reporting:** The Supplier is required to report any matter involving a violation of these rules of conduct, any matter involving health or safety, including any altercations, to WRDSB Facilities staff.

The Supplier is responsible for its employees, agents, consultants and guests. If prohibited conduct does occur, the Supplier will take all necessary steps to stop and prevent any future occurrence. Any breach of these conditions will result in the removal of the person responsible from the school premises and prohibited actions could result in the termination of any contract or agreement with WRDSB.

7. Compliance with Laws, Acts and Regulations

Suppliers shall abide by all applicable provincial and federal laws, as well as Board Policies. Some of the applicable laws are highlighted below for information purposes only. In case of any discrepancy between this Bid Solicitation Document and the provision of applicable laws, the latter shall prevail. This list is not intended to be a comprehensive summary of relevant laws or be a complete list of applicable regulations or interpretation of the provisions of any laws

- Accessibility for Ontarians with Disabilities Act (AODA)

- Architect Act
- [Bill S-211 Fighting Against Forced Labour and Child Labour in Supply Chains Act](#)
- Broader Public Sector Accountability Act, 2010
- Building Ontario Businesses Initiative (BOBI) Act, 2022
- Canada Revenue Agency (CRA) regulations
- Confidentiality Acts (MFIPPA, PIPEDA etc.)
- Construction Act
- Education Act
- Occupational Health and Safety Act
- Trade Agreements (CETA/CFTA etc.)
- Workplace Safety and Insurance Act (WSIB)
- [WRDBS Procurement Services Policies website](#)
- [WRDSB Policies and Procedures](#)

Non-compliance to provincial and/or federal laws, or Board Policies may result in rejection of the Bidder's Bid submission and/or termination of Contract.

Bidders shall make themselves aware of provisions in all applicable provincial and federal laws as well as Board policies and ensure full compliance. Non-compliance may result in rejection of Bid and/or termination of Contract.

The Supplier(s) will be required to comply with all applicable federal, provincial laws as well as Board policies in performing its obligations under the Contract including, without limitation, the Occupational Health and Safety Act, as amended, and the Workplace Safety and Insurance Act, 1997, as amended, and Accessibility for Ontarians With Disabilities Act, 2005, S.O. 2005, c.11, Accessibility Standards for Customer Services O. Reg. 429/07 requirements, under the Accessibility for Ontarians With Disabilities Act, 2005, as amended, or any successor legislation applicable, and to provide to the Board, upon request, periodic reports and evidences confirming such compliance.

By supplying the goods or equipment and/or providing services, the Supplier warrants that the goods or equipment supplied, and services provided to the Board conforms in all respects to the standards and codes set forth by federal and provincial agencies. Failure to comply with this condition will be considered a breach of this Contract.

The obligations of the parties and resolutions of any disputes shall be governed by and construed in accordance with the laws of the Province of Ontario and the federal laws of Canada, including the Construction Act, as to interpretation and performance, and shall be treated, in all respects, as an Ontario contract. The parties shall attorn to the exclusive jurisdiction of the courts of the Province of Ontario.

8. Confidential Information, MFIPPA, and PIPEDA

All information and documentation provided by the Board or to the Board in connection with this Procurement, before or after the issuance of this Procurement is the sole property of the Board and shall be treated as confidential, subject to the provisions of the Municipal Freedom of Information and Protection of Privacy Act (MFIPPA).

Bidders shall identify any confidential information in their Bid Submission. The Board will make reasonable efforts to safeguard confidential information, subject to its disclosure requirements under MFIPPA or any other disclosure requirements imposed by law or by order of a court or competent tribunal. Bidders are advised that their Bid submissions may be disclosed, on a confidential basis, to advisers retained by the Board to advise or assist with the Bid process, including the evaluation of Bid submissions.

Bidders should be advised that when submitting a Bid, the name, title, and contact information will be made public upon request. Under MFIPPA, and as a record of the Board, the Bid prices submitted and agreed to under contract with the Board can also be made available through a Freedom of Information request. Bidders will be notified regarding requests for any other information submitted in a Bid; information may be disclosed to a requester in whole or part unless otherwise considered exempt from disclosure under MFIPPA.

The Supplier represents and warrants that if it is or becomes subject to any private sector privacy legislation during the Term it will be solely responsible for compliance with such legislation. Without limitation, the Supplier represents and warrants that if it is subject to the *Personal Information Protection and Electronic Documents Act*, S.C. 2000, c.5, including any further amendments thereto (PIPEDA):

(a) it and all of the Supplier's Sub-contractors shall ensure the PIPEDA compliance of all PIPEDA Protected Information it collects directly from individuals or indirectly from the Board, uses or discloses in the course of performing their obligations under this Agreement; and,

(b) without limitation, it shall ensure the PIPEDA compliance of all PIPEDA Protected Information it transfers or discloses to the Board.

9. Confirmation to Proceed

No work shall commence until the Board has issued a purchase order and/or contract, if applicable to the Supplier. 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 and/or the CCDC 2 - 2020 if applicable, are executed by the Supplier and the Board. For payment purposes, a Purchase Order shall be generated and issued to the Supplier. The Purchase Order number must appear on all invoices in order to ensure prompt payment.

10. Conflict of Interest

By submitting a Bid, the Bidder confirms that they have no conflict of interest with respect to other work and/or other clients. The Bidder shall ensure that all Sub-contractors, sub-consultants and suppliers also have no conflict with respect to other work and/or other clients.

The Supplier, Sub-contractors and Sub-suppliers 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 Owner) with the provision of the Work pursuant to the Contract. The Supplier acknowledges and agrees that a conflict of interest, as described in this section includes, but is not limited to, the use of Confidential Information where the Owner has not specifically authorized such use.

The Supplier shall disclose to the Owner, 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 Sub-contractor or Supplier that is directly or indirectly affiliated with or related to the Supplier.

The Supplier covenants and agrees that it will not hire or retain the services of any employee or previous employee of the Owner where to do so constitutes a breach by such employee or previous employee of the Owner's conflict of interest policy, as it may be amended from time to time, until after completion of the Work/Services under the Contract.

It is of the essence of the Contract that the Owner shall not have direct or indirect liability to any Sub-contractor or Supplier, and that the Owner relies on the maintenance of an arm's-length relationship between the Supplier and its Sub-contractors and Sub-suppliers. Consistent with this fundamental term of the Contract, the Supplier will not enter into any agreement or understanding with any Sub-contractor or Supplier, 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 Owner, directly or through the Supplier, where such claim is, in whole or in part, in respect of a disputed claim by the Sub-contractor or Supplier against the Supplier, where the payment to the Sub-contractor or Supplier by the Supplier is agreed to be conditional or contingent on the ability to recover those amounts or a portion thereof from the Owner, failing which the Supplier shall be saved harmless from all or a portion of those claims. The Supplier acknowledges that any such agreement would undermine the required arm's-length relationship and constitute a conflict of interest. For greater certainty, the Supplier shall only be entitled to advance claims against the Owner for amounts pertaining to Sub-contractor or Supplier claims where the Supplier has actually paid or unconditionally acknowledged liability for those claims or where

those claims are the subject of litigation or binding arbitration between the Sub-contractor or Supplier and the Supplier has been found liable for those claims.

A breach by the Supplier, any of the Sub-contractors, Sub-suppliers or any of their respective advisors, partners, directors, officers, employees, agents, and volunteers shall entitle the Owner to terminate the Contract, in addition to any other rights and remedies that the Owner has in the Contract, in law, or in equity.”

11. Construction Act Guidelines

For Work that is governed by the provisions of the Construction Act, the Construction Act shall apply where applicable including in respect to release of 10% holdback, 2% deficiency holdback, adjudication, and the provision of security.

12. Criminal Background Checks and Collection of Personal Information

The Board must comply with Ontario Regulation 521/01 (Collection of Personal Information) of the Education Act with respect to criminal background checks and offence declarations.

If required by the Board, the Supplier will provide to the Board, or designate, a Criminal Background check for pertinent individuals 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.

An Offence Declaration on a Board-approved form for every employee of the Supplier who may come in 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 may be required. Updated Offence Declarations may be required annually. The Board will determine in its sole discretion whether this is a requirement.

Termination of contracts may be the result of non-compliance to this requirement.

13. Damage Responsibility of Supplier

The Supplier, their agents and all workers and persons employed by them or under their control, shall use due care that no person or property is injured and that no rights are infringed in the prosecution of the work, and the Supplier shall be solely responsible for all damages by whomsoever claimable in respect of any injury to persons or to lands, buildings, structures, utilities, survey markers, fences, livestock, trees, crops, roads, ways, ditches, drains and in watercourses, whether natural or artificial, or property or whatever description and in respect of any infringement of any right, privilege or easement whatever occasioned in the carrying on of the work or any part thereof, or by any neglect, misfeasance or nonfeasance on the Supplier's part or on the part of any of his agents, workers and persons employed by them or under their control shall bear the full cost thereof and shall at his own expense make such temporary

provisions as may be necessary to ensure the avoidance of any such damage, injury or infringement.

The Supplier shall indemnify and save harmless the Board from and against all claims, demands, loss, costs, damages, actions suits or other proceedings by whomsoever made, brought, or prosecuted in any manner based upon, occasioned by, or attributed to any such damage, injury, or infringement.

Notwithstanding the indemnity provisions contained in this section, where in the opinion of the Board Representative the Supplier has failed to rectify any damage, injury or infringement or has failed to adequately compensate any person for any damage, injury or infringement for which the Supplier is responsible under the Contract, the Board, following notice in writing to the Supplier of his intention so to do, may withhold payment of any monies due to the Supplier under this or any other Contract until the Supplier has rectified such damage, injury or infringement or has paid adequate compensation for such damage, injury or infringement.

14. Damage Reporting

If a utility structure or device, utility cable/conduit, or utility related infrastructure is damaged, the Supplier shall notify the Board representative the same working day of any service disruption or damage and the Supplier will immediately notify the utility company to initiate repair. The Supplier will additionally make every reasonable effort to advise impacted resident(s) of a service disruption.

It is understood that all damage caused by workers engaged in the work under these specifications will be repaired by the Supplier and at the Supplier's sole expense. Damaged turf areas will be levelled and seeded, all horticultural planting damaged beyond repair will be replaced and any damage to structures, utilities, signs, light fixtures, landscape furniture, irrigation systems etc. will be repaired or replaced. Repair work will be carried out by skilled workers acceptable to the Board representative. All repairs and replacements will be approved by a Board representative prior to final payment.

15. Debriefing Requests

For procurements valued at \$121,200 or more, and in accordance with the Broader Public Sector Procurement Directive, unsuccessful Bidders are entitled to a debriefing to receive feedback with respect to their Bid submission. To obtain a debriefing, Bidders shall contact the Single Point of Contact listed in this Bid Solicitation Document in writing with their request within sixty (60) calendar days of the award notification.

16. Default

If the Supplier fails to properly, promptly, and fully carry out the Work required by these documents, the Board reserves the right to notify the Supplier to discontinue all Work under this Contract, to advertise for new Bids or carry out the Work in any way as the Board may, in their sole discretion, deem best.

The Supplier further agrees to indemnify and save harmless the Indemnified Parties from all loss, damage, liability, cost, charge, or expense whatsoever which it, they or any of them may suffer, incur or be put to by reason of such default or failure.

17. Delay Claims

The Supplier shall be responsible for all deliverables including lead times. The bidder shall include in their bid price any costs associated with an extended schedule beyond the stated substantial completion date due to delayed deliveries of items. Costing is to be inclusive of any afterhours work required due to the school being occupied by staff and students during the school year until completion.

The board will not accept or consider any "delay claim" requests for delayed deliverables outlined in the tender documents.

18. Delivery and Transportation Charges

Unless otherwise specified under the Special Provisions and/or Scope of Work and Deliverables sections of this document, prices documented shall be net prices including transportation and delivery charges fully paid by the Supplier and Free On Board (FOB) Destination, Freight Prepaid (any/all Board locations).

19. Designated Substances

The Occupational Health and Safety Act of Ontario (OHSA) allows for certain toxic substances to be especially designated. The OHSA defines a designated substance as "a biological, chemical, or physical agent or combination thereof prescribed as a designated substance to which the exposure of a worker is prohibited, regulated, restricted, limited, or controlled". Ontario Regulation 490/09 - Designated Substances (O.Reg. 490/09), made under the Occupational Health and Safety Act outlines required steps to control exposure of workers to designated substances. Under O. Reg. 490/09 there are eleven (11) designated substances: acrylonitrile, arsenic, asbestos, benzene, coke oven emissions, ethylene oxide, isocyanates, lead, mercury, silica and vinyl chloride. This regulation applies to every employer and worker at a workplace where the designated substances are present, produced, processed, used, handled or stored and at which a worker is likely to be exposed to the designated substance.

I. Asbestos

Asbestos-containing material (ACMs) were identified during the completion of the Asbestos Audit Update Report (AAU), prepared by MTE Consultants Inc. Each facility was surveyed, and if applicable, an AAU Report is available, refer to attached, Appendix 01 35 34A. If these materials, including those deemed or suspected, will be disturbed, or will likely be disturbed, during building maintenance, renovations, construction, or demolition activities, they must be handled and disposed of in accordance with the procedures prescribed by O. Reg. 278/05.

Should the Supplier encounter asbestos, not noted in the above AAU Report, which 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.

All asbestos work must be conducted by Suppliers approved by the Board, who are trained in the type of asbestos operations required and should be overseen by a qualified third-party Health, Safety and Environmental professional. To conduct Type 3 asbestos operations, Suppliers 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 as prescribed by Section 20 of O. Reg. 278/05.

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 0.6 meter (2'-0") 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.

II. Lead

Lead was historically used in mortar pigments, ceramic glazing; plumbing solder, electrical equipment and electronics solder, in pipe gaskets as packing in cast iron bell and spigot joints of sanitary drains, flexible plumbing connections, flashing panels, acoustical dampeners, phone cable casing and some architectural applications. The assessment of lead for this assignment was limited to paint on interior and exterior surfaces which may be disturbed during the Work.

Preliminary paint, coatings or materials were collected within the work area to determine if lead-containing paints, including lead-based paints, are present. The analytical results, if applicable, including the location marked on the floor plans are available, refer to attached, Appendix 01 35 34B.

Should the Supplier encounter paint and coatings, not sampled, 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.

Unless otherwise specifically covered by Cash Allowance or Contingency Allowance for known lead-containing paint and coatings, include in this contract for the removal or disturbance of lead-containing materials, must be completed in compliance with "Lead on Construction Projects" guideline (April 2011). No claims for extra cost will be accepted for lead-containing paint or coatings in identified areas.

The classification of typical lead-containing construction tasks is based on presumed airborne concentrations obtained from the U.S. Occupational Safety and Health Administration (OSHA), the Ontario Ministry of Labour, and published research studies. The classification of Type 1, Type 2, or Type 3 operations are grouped based on the following concentrations of airborne lead

Supplier shall inform all workers of the presence of paint finishes that are lead containing. Disturbance of lead-containing materials, 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. Waste to be handled and disposed of in accordance with O.Reg. 347.

III. Mercury

Mercury is typically used in building service applications such as 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.

IV. Silica

Silica is present in rock, stone, soil, and sand. Masonry products such as concrete block, brick, and mortar, as well as concrete and associated products contain silica. Due to its ubiquitous nature, silica was historically used in a wide variety of building materials and is still used today in new construction.

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 Supplier shall implement dust suppression methods and protect workers.

V. Other Designated Substance

In addition to asbestos and/or lead, silica, and mercury are present in all WRDSB facilities. New construction, renovation or alterations require compliance by the Supplier 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. responsible for obtaining its own independent financial, legal, accounting, and technical advice with respect

to any information included in the Bid Solicitation Document or in any data, materials, or documents provided or required by the Board.

20. Dispute Resolution

All disputes arising out of or in connection with this Contract, or in respect of any legal relationship associated with or derived from this Contract, other than with respect to the Board's right to terminate this Contract, shall first be mediated pursuant to the [National Mediation Rules of the ADR Institute of Canada, Inc.](#) Despite this agreement to mediate, the Supplier or the Board may apply to a court of competent jurisdiction or other competent authority for interim measures of protection at any time. All disputes remaining unsettled after mediation shall be arbitrated and finally resolved before a single arbitrator pursuant to the National Arbitration Rules of the ADR Institute of Canada, Inc. The place of mediation and arbitration shall be Toronto, Ontario, Canada. The language of the mediation shall be English.

21. Electrical Safety Requirements

All electrical equipment and components must be C.S.A. or Electrical Safety Association (E.S.A.) certified. A certification sticker must be affixed to the equipment in a visible location.

22. Emergency and Maintenance

The care of the Works until completed, delivered to and accepted by the Board rests solely with the Supplier who shall assume all risk of damage to the work.

For the purpose of emergency and maintenance measures, the name, address, and telephone number of a responsible official of the contracting firm shall be given to the Board's contact person in charge of the project, if requested. This official shall always be available and have the necessary authority to mobilize workers and machinery and to take any action as directed by the Board in the event emergency or maintenance measures are required, regardless of the fact that the emergency or requirement of maintenance may have been caused by the Supplier's negligence, Act of God, or any cause whatsoever.

Should the Supplier be unable to carry out the required immediate remedial measures, the Board may carry out the necessary repairs and the costs for this work shall be deducted from payments due to the Supplier.

23. Equivalent or Brand Name

Any reference to a brand name or a particular manufacturer shall be understood to have been made solely for the purpose of establishing and describing required performance and quality levels of the product to be supplied, unless specified otherwise.

No reference to the brand name of a particular manufacturer shall be construed to restrict Bidders to that manufacturer. Bidders are invited to Bid equivalent and comparable equipment or items of any manufacturer, pending approval from the Board in the form of an Addendum. It is the Bidder's responsibility to demonstrate that the item meets the specifications.

Bidders shall request through the Bidding System by clicking on the "Submit a Question" button found within the bid details page of that Procurement that a proposed product be considered an approved equivalent prior to the Deadline for Questions in the Anticipated Project Schedule.

The request must include enough detail to determine equivalency by comparing the Board's specifications to the alternate product. It will not be the Board's responsibility to perform this comparison.

The Board/ Consultant may, depending on the nature of the product request site visits within a reasonable distance (preferable within 100 km of the Board) showing product and installation based on a certain age, minimum 18 months in use, room use, room size, etc. based on same or similar purpose as described in this Procurement.

The Board/Consultant will endeavor to complete a review and make a decision prior to the Closing Date, and, if required, the Board reserves the right to extend the Closing Date to complete its review. However, in the event additional time is required beyond a suitable extension to the Closing Date, the request will be pending until the product is thoroughly vetted, therefore, it may not be approved for this particular Procurement.

If the Board is willing to consider the product with its differences, it will be communicated in the form of an Addendum prior to the Closing Date.

The cost of any testing requirements to establish acceptable equivalent or comparable products will be borne by the Bidder, unless otherwise stated by the Board.

24. Evidence of Quality

It is the Bidder's responsibility to prove their product/service quality meets the Board's requirements and Bidders may be required to submit evidence in a form acceptable to the Board. Substitution of materials equipment or methods different from that outlined in the specifications / terms of reference will not be accepted unless provided for within the Bid Solicitation document or without the written approval of the Board.

25. Force Majeure

If either party is delayed in the performance of their obligations under this Contract by Force Majeure, then the Contract Time shall be extended for such reasonable time as the Owner and the Supplier 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 Contract Time attributable to the Force Majeure event, the Owner and the Supplier shall execute a Change Order indicating the length of the extension to the Contract Time and confirming that there are no costs payable by the either party for the extension of Contract Time. However, if at the time an event of Force Majeure arises a party is in default of its obligations under the Contract and has received a notice of default 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 Force Majeure.”

Any cause, unknown at the effective date of the Contract and beyond either party's control, other than financial difficulties, bankruptcy or insolvency, which prevents the performance by a party, or both, of any of their respective obligations under the Contract and the event of Force Majeure did not arise from a party's default and could not be avoided or mitigated by the exercise of reasonable effort or foresight. Force Majeure includes Labour Disputes; fire; unusual delay by common carriers or unavoidable casualties; delays in obtaining third-party licenses, permits, agreements, or approvals (excluding approvals of any Sub-contractors or Suppliers of any tier); civil disturbance; emergency acts, orders, legislation, regulations or directives or revoking of funding from 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 Place of the Work; acts of God; or declared epidemic or pandemic outbreak or other public health emergency (e.g. SARS, COVID-19)

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 Bidder 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.

26. Hold Back or Set Off

The Board may hold back payment or set off against payment if, in the opinion of the Board, the Supplier has failed to comply with any requirements of the Contract.

27. Hot Work Procedure

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:

- i. Whenever possible, complete Hot Work in a welding shop or out of doors at the school.
- ii. 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.
- iii. Explosive atmosphere in area eliminated. Floors swept clean. Combustible floors wet down, covered with damp sand or fire-resistive tarpaulins.
- iv. All wall and floor openings covered. Fire-resistive tarpaulins suspended beneath Work.

- v. For on-site Work (indoor and out of doors), advise the Head Custodian, Principal, Consultant (if assigned) and Project Coordinator/Lead prior to Work being performed, and of related dangers.
- vi. 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.
- vii. 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.
- viii. 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.
- ix. 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.
- x. Provide and keep fire extinguishers handy and in good Working condition. Temporarily cover all smoke detectors in the area during time of Work.
- xi. Provide a fire watch/spot check for several hours after Work is completed. Uncover smoke detectors.
- xii. 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.
- xiii. On additions to existing buildings, the requirements for Hot Work permits shall remain in place.

27.1 Hot Work Permit

- i. Each permit is valid for seven (7) days only and must be renewed prior to its expiration date
- ii. The contractor must obtain Hot Work Permits from the School Board's representative prior to the start of work.
- iii. The contractor must complete the form as required and must keep the form on site.
- iv. Return each completed form to the School Board's representative on the date of expiration.
- v. The most current version of the Permit and its requirements shall be used for the purposes of the Work.

28. Incurred Costs

The Board will not be liable, nor reimburse any Bidder for costs incurred in the preparation of the Bid, or any other services that may be requested as part of the procurement process.

29. Indemnification

The Bidder will indemnify and save harmless and defend the Board, and their respective elected officials, officers, employees, agents and their respective successors and assigns, from and against all actions claims and demands whatsoever which may be brought against or made upon any of the Indemnified Parties and against all losses, liability, judgments, claims, costs, demands or expenses which the Indemnified Parties may sustain, suffer, or be put to resulting from or arising out of the Bidder's failure to exercise reasonable care, skill or diligence in the performance or rendering of any Work or service required hereunder to be performed or rendered by the Bidder, its agents, servants, employees or Sub-contractors, or any of them as well as for the infringement of or use of any intellectual property rights including any copyright or patent arising out of the reproduction or use in any manner of any plans, designs, drawings, specifications, information, negatives, data, material, sketches, notes, documents, memoranda, or computer software furnished by the Bidder in the performance of this Contract.

30. Inspection of Supplier's Work.

The Board reserves the right to have all work including maintenance and repair work reviewed by a third-party Contractor, Agency or Consultant to confirm that work within this Contract is being completed satisfactorily.

31. Insurance Requirements

If selected, it is the responsibility of the Supplier and its Insurance Broker to review all potential operations and exposures to determine if the coverage and limits noted below are sufficient to address all insurance related exposures presented by the specification of the Project, Work, or Supply. The Supplier shall insure its undertaking, business, and equipment under the following coverage to protect and indemnify and save harmless the Board.

Throughout the term of this Contract (including any renewal thereof), the Supplier shall obtain, upload through bids&tenders and maintain at its own expense, including the cost of any applicable deductible or self-insured retention, the following policies of insurance:

- i. **Commercial General Liability Insurance** shall be in the name of the Supplier, and shall name the **Waterloo Region District School Board** and any other person or party identified in the contract documents, as an **additional insured**, with limits of not less than \$5,000,000.00 inclusive per occurrence for bodily injury, death, and damage to property, including loss of use thereof, for itself and each of its

employees, *Subcontractors* and/or agents. To achieve the desired limit, umbrella, or excess liability insurance may be used. 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.

- ii. **Automobile Liability Insurance** in respect of licensed vehicles with 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 Supplier, 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 Supplier shall provide the Owner with confirmation of automobile insurance coverage for all automobiles registered in the name of the Contractor
- iii. **If applicable, Broad Form Contractor's Equipment Insurance:** The General Contractor shall provide and maintain during the term of the Agreement, coverage for construction machinery and equipment used by the Contractor for the performance of the work. Such insurance shall be in a form acceptable to the Board and shall not allow subrogation claims by the Insurer against the Board.
- iv. **If applicable,** the General Contractor shall provide and maintain during the term of the Agreement an **All Risk Installation Floater Insurance** policy covering the installation of any machinery and equipment associated with the construction project. Coverage shall be in an amount equal to the value of the machinery and/or equipment and shall include coverage while it is in transit to, while stored at a temporary location, and awaiting installation at the work site.
- v. **If applicable,** the General Contractor shall **ensure** its professional consultants, architects, landscape architects, planners, and engineers providing a professional service in connection with the contract, maintain until three (3) years after the Agreement, **Professional Liability Insurance** to a limit not less than \$1,000,000 per claim providing coverage for acts, errors and omissions arising from their professional services performed under this Agreement. The policy SIR/deductible shall not exceed \$100,000 per claim and if the policy has an aggregate limit, the amount of the aggregate shall be double the required per claim limit. Certificates evidencing such coverage shall be supplied to the Board prior to the completion of the project and in accordance with the provisions stated above.
- vi. **If applicable, (i.e., for projects with environmental liability concerns)** the General Contractor shall take out and keep in force **Contractor's Pollution Liability (CPL)** coverage to ensure that its work does not exacerbate any pre-existing environmental condition during construction. Coverage shall be in an amount of not less than \$5,000,000 per claim or per occurrence, or such greater amount as the Board may from time to time require, naming the Board as an additional insured,

whose coverage shall be maintained in force for 1 year following the termination of the Contract. The policy SIR/deductible shall not exceed \$100,000 per claim and if the policy has an aggregate limit, the amount of the aggregate shall be double the required per occurrence limit.

- vii. **Provisions:** Prior to the commencement of work, the Supplier shall forward a Certificate of Insurance evidencing this insurance with the executed Agreement. The Certificate shall state that coverage will not be suspended, voided, canceled, reduced in coverage or in limits except after thirty (30) days (ten (10) days if cancellation is due to non-payment of premium) prior written notice by certified mail to the Board.

It is also understood and agreed that in the event of a claim any deductible or self-insured retention under these policies of insurance shall be the sole responsibility of the General Contractor and that this coverage shall preclude subrogation claims against the Board and any other person insured under the policy and be primary insurance in response to claims. Any insurance or self-insurance maintained by the Board and any other person insured under the policy shall be considered excess of the Contractor's insurance and shall not contribute with it. The minimum amount of insurance required herein shall not modify, waive or otherwise alter the Contractor's obligation to fully indemnify the Board under this Agreement.

The Board reserves the right to modify the insurance requirements as deemed suitable.

viii. **Third Party Claims Process:**

- a. The Board's claims process for Third Party claims is to refer the claimant directly to the Supplier and to leave the resolution of the claim with the Supplier. This applies regardless of whether or not it is an insured loss.
- b. As the Board has a responsibility to the taxpayers, we must ensure that claimants are dealt with in a fair and efficient manner. Claims reported to the Supplier, either directly by a third party or through the Board shall be promptly investigated by the Supplier. The Supplier shall contact the third party claimant within 48 hours of receipt of notice of a claim. The Supplier shall initiate an investigation of the claim immediately upon notice, and advise the third party claimant in writing, with a copy to the Board, of its position regarding the claim within 21 calendar days of the notice. The Supplier shall include in its response the reasons for its position.
- c. Should this position not resolve the claim and be accepted by the third party claimant, the Supplier shall immediately report the claim to its Insurer for further review. (Insurer for this purpose is defined as either the Claims Department of the Supplier's Insurance Company or the Claims Administrator at the Supplier's Insurance Broker.)The Supplier's Insurer upon

receipt of this claim shall advise the third party claimant by letter, with a copy to the Board, that it is now investigating the claim. When a final position on the claim has been determined, the Supplier's Insurer shall advise the third party claimant by letter, with a copy to the Board. Failure to follow this procedure shall permit the Board to investigate and resolve any such claims.

- d. Nothing herein shall limit the right of the Board to investigate and resolve any such claims notwithstanding the response of the Supplier and/or its Insurer and to seek indemnification from the Supplier or to exercise any other rights under the Contract.
- e. The Board may, without breaching this contract, retain from the funds owing to the Supplier an amount that, as between the Board and the Supplier, is equal to the balance in the Board's favour of all outstanding debts, claims or damages, whether or not related to this contract.

32. Invoicing and Payment Terms

- a) **Submit all invoices** to finance-ap@wrdsb.ca for payment at the completion of the Work or after receipt of goods, unless otherwise stated. Not Applicable for Credit Card orders.
- b) **Fiscal Year End:** All work scheduled within a single school year (Sept 1-Aug 31) must be completed and invoiced received by the Board no later than August 31 of that same school year, unless budgets dictate that work must extend into the following school year and/or mutually agreed upon both parties.
- c) **New Account**, in advance of invoicing, upon request, Suppliers will provide:
 - i. necessary company information to set up a WRDSB account and
 - ii. banking information to receive payment by Electronic Funds Transfer (EFT).
- d) **Requests to change company information** must be submitted in writing accompanied with a legal document/letter signed by a lawyer on the law firm's letterhead.
- e) **Invoices must contain** the following information, where applicable, in order to be deemed complete:
 - i. Purchase Order Number
 - ii. Invoice Date
 - iii. Unique Invoice Number
 - iv. Supplier name and address
 - v. Quantity, Unit Price, Unit of Measure and Extended Price
 - vi. Description for each line item
 - vii. Date of Service Call, if applicable
 - viii. HST
 - ix. Payment Terms
 - x. Work Order Number, if applicable
 - xi. WRDSB Project Lead, if available, and

- f) **Payment terms** shall be net twenty-eight days (28) days after receipt of proper invoice where the Construction Act is applicable, unless otherwise agreed by the Board in writing. All other payment terms will reflect Net 30. An early payment discount, if offered, may be considered on a mutual agreement basis. Payment may be delayed if the invoice is incorrect or the goods, equipment and/or services are not acceptable to the Board. The Board will not pay any interest, penalty, or late fee for delayed payments. The Board preferred payment method is Credit Card or EFT, however alternate payment methods may be approved. Suppliers are required to invoice promptly, without delay.

32.1 Construction Act – Proper Invoice

The Board will pay such invoice within twenty-eight (28) calendar days of the Board's receipt of such proper invoice if the work has been performed to the satisfaction of the Board. For Work that is governed by the provisions of the Construction Act and the Regulations thereto, the Supplier shall submit its invoices in the form of a Proper Invoice. For the purposes of this section, a "Proper Invoice" shall include the following:

- i. the Supplier's name, address, telephone number and mailing address.
- ii. the date of the Proper Invoice and the period during which the services or materials for which payment is being applied for were supplied.
- iii. information identifying the authority, whether in the contract or otherwise, under which the services or materials were supplied.
- iv. a description, including quantity where appropriate, of the services or materials that were supplied during the payment period.
- v. the amount payable for the services or materials that were supplied during the payment period, with a clear identification of the portions of the amount that are holdbacks, and HST.
- vi. the name, title, telephone number and mailing address of the person to whom payment is to be sent.
- vii. the payment terms as specified by the Board in the Contract.
- viii. the invoice number and if applicable, the revision number.
- ix. the Supplier's HST number.
- x. invoices and time sheets from all subtrades whose work is included in the Proper Invoice, if required in the Contract.
- xi. backup documentation to support any cash allowances and extra work claimed in the Proper Invoice.
- xii. a schedule of values indicating:
 - a. for lump sum contracts, the percentage of work completed per division with each division further subdivided to show the percentage of work completed for each subtrade,
 - b. for unit price contracts, the tender quantity, unit of measure, previous quantity, current quantity, to-date quantity,
 - c. an updated list of change orders, showing the percentage of work

- completed under each change order, and
- d. an updated cash allowance list, showing the percentage of work completed in respect of each cash allowance, if required by the Contract.
- xiii. a Statutory Declaration where required by the Contract attesting to the truth of the statements made therein.

33. Licenses and Permits

The Supplier will be responsible for applications and fees associated with any and all licenses and permits required by any and all governing bodies. The Supplier will attach a copy of all permits, and any other required documentation to the applicable assigned work order for Board records.

34. Locates, if applicable

All required utility locates must be obtained before any on-site work commences, be available for Supplier operator/employee review, and are the sole responsibility of the Supplier. Any damage to any utility installation arising from work performed by the Supplier or their employees shall be the Supplier's responsibility.

The Supplier will obtain all utility locates in advance of work and all cost(s) associated with obtaining the utility locates will be the Supplier's responsibility.

The Supplier shall possess the ability to supply and or share with the Board Representative utility locates for the sole purpose of Quality Control inspections. This is to be done at no additional cost to the Board.

35. Log Reports

If required, the Supplier must submit a completed Log Report with invoices. The Board may request more frequent log submissions ifdeems necessary.

36. Materials - Specifications

Only new materials in perfect condition will be accepted. 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 Supplier at the Supplier's expense.

37. Material Safety Data Sheets (M.S.D.S.)

Where applicable, a materials safety data sheet (M.S.D.S.), musts accompany all purchased goods, that fall under the requirements of the Occupational Health and Safety Act. The Board will not accept any additional charges or surcharges related to the supplying of M.S.D.S.

38. Mathematical Errors (Unit Prices Prevail)

Should there be any error in extensions, additions or computations, the Board shall be entitled to correct such errors based upon the unit prices supplied, and the corrected total shall be considered as representing the intention of the Bidder and shall be used as the basis for comparison of bid submissions.

39. No Branding

The Supplier shall not place any sign at the site, public meetings, any public or private property or along curbside prior, during or after the Work without prior written permission of the Board.

40. No Collusion

Bidders including any of their agents are prohibited from engaging in any comparison of figures or arrangement with any other individual, corporation or person submitting a Bid for the same Work and shall be fair in all respects and shall be without collusion or fraud.

41. No Lobbying

Any attempt by the Bidder or its agents to contact any of the following persons, directly or indirectly, with respect to this procurement may lead to disqualification:

- i. any elected or appointed officer.
- ii. any staff of the Board except the Single Point of Contact as identified in the Bid Solicitation Document; or
- iii. any other person connected in any way with the procurement.

42. No Smoking and Scent-Free Environment

The Province of Ontario 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.

43. Non-Assignment

No assignment by the Supplier shall relieve the Supplier of any responsibility for the full performance of all its' obligations under this contract.

The Supplier shall not change its corporate name without the prior written approval of the Board.

44. Non-Disclosure Agreement (NDA)

The Board requires all service providers to sign off on a non-disclosure agreement and for the service provider to complete the Software Privacy and Security Standards Document (if necessary) in accordance with Board procedure AP4790. Prior to any sharing of Board personal, sensitive, or confidential information, the Supplier will be subject to further privacy and security reviews as required. This agreement will be renewed on an annual basis.

45. Ownership of Work

For the purposes of this paragraph:

" Deliverables " means all material prepared by the Bidder forming the Work under this Contract including, without limitation, all electronic media, reports, documents and

instruments of service.

" Intellectual Property Rights " means any and all rights provided under:(a) patent law; (b) copyright law; (c) trade-mark law; (d) industrial design law; (e) any other statutory provision or common law principle applicable to this Contract, including trade secret law; and (f) any and all registrations and licenses in relation to the foregoing; and

" Personnel " means employees, representatives, agents and Sub-contractors.

The Bidder and the Board acknowledge and agree that the development of the Deliverables and the provision of the Work may result in the creation or development of new intellectual property and may contain or utilize the existing intellectual property of the Bidder or of third parties. Accordingly, the Bidder and the Board agree as follows.

- i. Except as set out in paragraph (b) below, the Bidder hereby assigns and agrees to assign to the Board all right, title and interest, including all Intellectual Property Rights, in and to each Deliverable from the moment of creation, and will cause its Personnel to assign the same. The Bidder will cause its Personnel to waive all moral rights they may have in each Deliverable.
- ii. To the extent that a Deliverable contains or utilizes the intellectual property of the Bidder or a third party ("Retained Materials"), and the Bidder expressly identifies such Retained Materials, the Bidder and the applicable third party will, subject to the following sentence, retain all their respective right, title and interest, including all Intellectual Property Rights, which each may have in such Retained Materials. To the extent that a Deliverable contains or utilizes Retained Materials, the Bidder hereby grants to each of the Board a royalty-free, irrevocable, perpetual, world-wide, non-exclusive license to make, use, sell, modify, prepare derivative works, disclose, publish, sublicense, copy and communicate by electronic means such Retained Materials.
- iii. The Supplier agrees to always cooperate fully, and will cause its Personnel to cooperate fully at all times, with respect to signing such documents and doing such acts and other things reasonably requested by the Board to confirm the transfer of ownership rights in the Deliverables.

46. Patent, Copyright and Other Proprietary Rights

The Bidder (by responding) agrees that the Bid on acceptance by the Designated Representative, become the property of the Board. The copyright for respective purchased concepts and/or materials will become the property of the Board unless otherwise mutually agreed upon by the Bidder and the Board.

All Bids, other documents as well as correspondence are subject to the provisions of the Municipal Freedom of Information and Protection of Privacy Act (MFIPPA).

47. Performance

- i. Where the Supplier is in default in carrying out any of its obligations under the contract, the Board may issue a verbal warning outlining the deficiency in supply or

- other aspects of performance and requiring the Supplier to correct those deficiencies within such period of time as stated.
- ii. If the deficiency is not corrected within the time specified, or there is a further instance of deficient performance, the Board may issue a written notice to the Supplier, identifying the deficiency in performance and setting a final date or time period for its correction.
 - iii. If corrective steps are not taken by the final date or within that time, the Board may terminate the Contract and take corrective action.
 - iv. Termination of any Contract can be immediate depending on the severity of the default.
 - v. The Supplier shall have no right to perform the services contemplated under this agreement beyond the time when such services become unsatisfactory to the Board; and in the event that Supplier shall be discharged before all the services contemplated hereunder have been completed, or the services are for any reason terminated, stopped or discontinued because of the inability of the Supplier to serve under this agreement they shall be paid only for that portion of the Work which shall have been satisfactorily completed at the time of termination.
 - vi. Where deemed appropriate, a performance evaluation shall be completed by the Board. The evaluation report shall be reviewed with Procurement Services, and a copy of the completed evaluation forwarded to the Supplier for their records. Dependent on the evaluation scoring, the Board may request a corrective action plan and/or project size/value may be affected on future bid opportunities for your company.

48. Permits and Licenses

Unless stated otherwise, the Supplier shall apply for all required permits and licenses, supply all necessary notices required for the Work and pay all required fees. These costs shall be included in the Total Price. A copy of all permits, and any other required documentation shall be provided the Board upon request.

49. Proceedings Against the Board

The Bidder represents and warrants that the Bidder is not a party to any legal suits, actions, litigation proceedings, arbitrations, alternative dispute resolutions, investigations, or claims (Hereinafter collectively referred to as "Claims") by or against or otherwise involving the Board and the Bidder. The Board may reject any Bid in the event of potential, current, pending, or threatened litigation, arbitration, alternative dispute resolution or disputes involving the Board and the Bidder.

50. Protection of Board Assets

The Supplier (the Supplier / Sub-contractor) shall be informed of and protect all Board assets including existing structures and vehicles, to the satisfaction of the Board. Any damage shall be reported to the Board and subsequently repaired and/or replaced by the Supplier, at their expense, to the satisfaction of the Board. The Supplier shall not cause any inconvenience to Board operations, staff, public or users of the Board facilities, within reason. Communication between the successful Supplier and the school (or Board representative if school contact is not available) must be timely and effective to ensure all stakeholders are considered / aware of work to be completed.

51. Public Health Safety Protocol

Best practices include but not limited to wearing a medical grade mask and maintaining physical distancing (2m/6.5ft).

Recommended practices are subject to change at any time For information and updates, refer to the following resources and website: [Waterloo Region District School Board](#) and [Regional of Waterloo Public Health Services](#)

52. Records, Inspection, Audits

The Board will have the right, upon reasonable notice, to full access to the accounts and records of the Supplier in respect of the goods, services and equipment provided by it under the Contract, for the purposes of inspection and/or audit. The Supplier shall make and retain such records during the term of the Contract and for a minimum of seven (7) years following its termination, cancellation, or expiry.

53. Reserved Rights of the Board

The Board reserve the right, in their respective sole and unfettered discretion, to:

- i. Reject any Bid received from a Bidder which is party to any potential, current, past or existing suits, actions, and litigation proceedings, arbitrations, alternative dispute resolutions, investigations, Bidder performance evaluations that are below expectations, significant or persistent deficiencies in performance of any substantive requirement or obligation under a prior agreement or agreements or claims by or against or otherwise involving either of the Board and the Bidder.
- ii. waive formalities and accept Bids which substantially comply with the requirements of this tender.
- iii. accept any Bid in whole or in part.
- iv. accept, reject, or cancel any or all Optional pricing.
- v. discuss with any Bidders different or additional terms to those contemplated in this Bid Solicitation Document or in any Bid submission.
- vi. make public the names of any or all Bidders.
- vii. accept or reject equivalent or alternative brand names.
- viii. check references other than those provided by any Bidder.
- ix. Verify with any Bidder or with a third party any information set out in a Bid.
- x. reject any, or any part of, any or all Bids, or cancel the bidding process at any stage and/or issue a new Bid call for the same or similar deliverables.

- xi. disqualify any Bidder:
 - a. whose Bid contains misrepresentations or any other, inaccurate, or misleading information, or any qualifications within its Bid,
 - b. who has engaged in conduct prohibited by the Bid Solicitation Document,
 - c. with inadequate credentials or due to unsatisfactory past performance,
- xii. reject Bid(s) from Bidder who has engaged in lobbying or has contravened any of the terms of the Bid Solicitation Document.
- xiii. reject a Bid based on:
 - a. information provided by references or credit check or other due diligence efforts,
 - b. the information provided by a Bidder pursuant to the Board exercising its clarification rights under the procurement process, or
 - c. other relevant information that arises during the procurement process.
- xiv. choose to reject a Bid if only a single Bid is received and cancel the bidding process or enter into direct negotiations with the sole Bidder.
- xv. accept a Bid other than the lowest or highest scoring and/or to not accept any Bid for any reason whatsoever.
- xvi. award the contract as split-order, lump sum or individual-item basis, or such combination as shall best serve the interests of the Board.
- xvii. negotiate in circumstances permitted for in the Bid document or by relevant policies, or directives, and include additional terms and conditions during the process of negotiations.
- xviii. no longer consider a Bidder if a satisfactory outcome is not reached as part of negotiation, as determined by the Board in their sole discretion and move to the next highest ranked Bid in such event.
- xix. select a Bidder other than the Bidder whose Bid reflects the lowest cost to the Board and/or award the Contract to any Bidder.
- xx. award any business/Work described in this Bid Solicitation to more than one (1) Bidder.
- xxi. not award the Contract if the costs of completing the Work exceed budget funding; or do not respond to all requirements or do not represent fair market value or where necessary internal approvals are not obtained, and
- xxii. If the Board receives a bid from a Supplier with Rates that are abnormally lower than the Rates in other Bids, the Board may verify with the Bidder that the Bidder satisfies the conditions for participation and is capable of fulfilling the Agreement.

These reserved rights are in addition to any other expressed rights or any other rights which may be implied in the circumstances. The Board shall not be liable for any expenses, costs or losses suffered by any Bidder or any third party resulting from the Board exercising any of its express or implied rights under this bidding process.

54. Responsibilities of the Supplier

Acceptance of a purchase order issued by the Board and/or a signed agreement shall constitute a contract (the "Contract") between the Board and the Supplier, which shall bind the Supplier on their part to furnish and deliver the goods, equipment and services at the prices given and in accordance with the conditions of the Bid solicitation document.

The Supplier shall:

- i. perform the Contract in accordance with the specifications, terms and conditions under which it is awarded.
- ii. act in a professional manner at all times when dealing with Board staff, with the public, and while working on site.
- iii. not, except with the consent of the Board in writing, release information relating to any subsequent order for advertising, promotional or technical purposes or otherwise give it publicly in any fashion, nor shall the name of either of the Board be used for, or in connection with, any advertising or promotional purpose of the Supplier.
- iv. treat information gained while working with the Board confidentially and not use it for any other project and return it to the Board if requested.
- v. submit to Finance – Accounts Payable, an invoice for payment at the completion of the Work, unless otherwise stated. All applicable taxes including HST are to be itemized separately on invoices. Include the purchase order number on each invoice; and
- vi. provide necessary information if they wish to receive payment by Electronic Funds Transfer (EFT).

55. Site and Work Examination

- i. Bidders will accept the site conditions, and the requirements of the Work, as is. No modifications to the Bid will be accepted after the Closing Time.
- ii. No claim for extras will be allowed for Work or difficulties encountered due to conditions of the site which were visible, knowable, or reasonably inferable, prior to the time of submission of Bid. Bidders shall accept sole responsibility for any error or neglect on their part in this regard.
- iii. Before submitting a Bid, each Bidder shall:
 - a. carefully examine this entire Bid Solicitation Document to determine the extent of the Work, and various provisions including the maps, drawings, reports and specifications.
 - b. immediately report all discrepancies between the various documents and site conditions.

- c. provide Sub-contractors, sub-consultants, and suppliers to whom the Bidder intends to sublet a portion or portions of the Work with complete information as to the requirements of the Work. This is to include maps, drawings, reports, specifications, and all requirements of the Bid Solicitation Document including any addenda.
- iv. In the event of discrepancies between the maps, drawings, reports, and the specifications with regard to quantity or quantities of materials or items, and in the absence of Addenda in clarification of said discrepancies, the Bidder is to include for the larger quantity or quantities.
- v. No additional payments will be made for any costs incurred through failure of the Bidder to abide by provisions stipulated in all of the articles and sub-articles of this item.
- vi. 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, nor does either assume any responsibility for any interpretations or conclusions that bidders may make or draw from the Reports or the Data.
- vii. 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. The Bidders' obligations set out in this paragraph apply irrespective of any Reports, Data or any information contained in the Bid Documents.
- viii. 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.

56. Site Existing Services, if applicable

The position of utility pole lines, underground conduits and services, watermains, sewers and other underground and over ground utilities and structures are not necessarily known, and the accuracy of the position of such utilities and structures on any reference documents is not guaranteed. The Board will not be responsible for damages or extra work caused or occasioned by the Supplier relying on this or any other information or records.

Before starting work, the Supplier shall familiarize themselves of the exact location of all such utilities and structures and shall assume all liability for damage to them. Where extra measures are required to support utility poles during construction either by the utility involved or the Supplier themselves, the costs involved shall be borne by the Supplier. The Supplier will be responsible for any fees that may be associated with these services.

57. Site Inspection and Control

A representative of the Board (appointed by the Board) reserves the right to enter the site at any time for the review & inspection. The presence of a said representative does not indicate satisfaction or compliance unless these comments are made by the representative and submitted to the Supplier in written form

58. Site Investigation

Bidders shall not rely solely upon information furnished by the Board but shall do their own investigation of the locations, and quantity of the work to be completed under this contract.

The Bidder assumes all risk of conditions, existing or arising, in the course of the work, which might or could make the work or any items therefore more expensive in character, or more onerous to fulfill, than was contemplated or known when the Bid was made, or the Contract signed.

59. Site Safety and Clean Up

For safety of students, staff, and community members alike, it is expected that cleanup operations will progress with the job.

Repair work will be carried out by skilled workers acceptable to the Board Representative, under the liability of the Supplier.

The Board Authorized Representative must approve all repairs and replacements prior to final payment.

60. Suspension of Bidders

At the sole discretion of the Manager of Procurement Services, any Bidder may be suspended from consideration for default of delivery, unsatisfactory performance, safety concerns, lobbying or contravention of the Bid Solicitation Document.

61. 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.

62. Termination

If the Supplier fails to comply with any provision of this agreement or otherwise fails to perform its obligations hereunder in a competent manner satisfactory to the Board, the Board may give the Supplier notice in writing of such failure. If the Supplier has not remedied its failure within ten (10) working days of the said notice, the Board shall be entitled to exercise any one or more of the following remedies:

- i. The Board may terminate the contract without further notice, and exercise its rights to the Contract security provided by the Supplier.
- ii. The Board may withhold any payment due to the Supplier hereunder until the Supplier has remedied its failure.
- iii. The Board may engage the services of another Bidder to remedy the Supplier's failure, and obtain reimbursement therefore from the Supplier. The said reimbursement may be obtained either through deduction from any amounts owing to the Supplier hereunder, or through any other legal means available to the Board; or
- iv. The Board may assert any other remedy available to it in law or equity.

Unless the Board expressly agrees to the contrary, any failure of the Board to exercise any of the foregoing remedies, or the granting of any extension or indulgences, shall not be prejudicial to any right of the Board to subsequently obtain such remedies.

63. Termination for Convenience

The Board may terminate the Contract, in whole or in part, whenever the Board determine that such termination is in the best interests of the Board without showing cause, upon providing written notice to the Supplier. The Board shall pay all reasonable costs incurred by the Supplier/Contract up to the date of termination considering the Work performed and/or services were provided in accordance with the Contract and to the complete satisfaction of the Board. Payment shall be in accordance with prices as per Contract. However, in no event shall the Supplier be paid an amount, which exceeds the Total Bid Price. The Supplier will not be reimbursed for any profits which may have been anticipated but which have not been earned up to the date of termination.

64. Termination for Lack of Funding

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 Supplier receives thirty (30) days written notice of such termination from the Board.

65. Tools and Equipment

All equipment and methods used to carry out this Contract shall be in accordance with best practices, guidelines, regulations, and standards with respect to safety and quality.

No equipment, tools or materials are to be stored or left overnight within Board property.

At the time of bid, if requested, the bidders will indicate the type of equipment that will be used to fulfill the terms and conditions of this contract. Prior to the Board entering into an agreement with the Supplier, or at any time during the Contract, the Board may, at their discretion, request an inspection of the equipment proposed for use.

It is the responsibility of the Supplier, in the event of a major mechanical equipment breakdown, to have available substitute equipment of similar capability. It shall be supplied and put into service to fulfill the timeline terms of this tender. Failure to provide alternative equipment within timeline expectations specified within this tender, may result in termination of the contract. It is the responsibility of the Supplier to ensure work continues and deadlines are met, despite any unforeseen interruption as a result of equipment failure.

It is the Supplier's responsibility to ensure that the equipment and the operator, are licensed in accordance with the Ministry of Transportation. The Board may, at their discretion, require the Supplier to provide proof that the equipment has passed a recent (within the last 12 months) government safety inspection and that the operators are suitably licensed prior to commencement of the contract. All vehicles, tools, equipment, and voltage rated gloves requiring dielectric testing shall have current certification and all applicable documentation.

The equipment must be in good working order and the Supplier is responsible for all general and preventative maintenance, fuel, and repair and those costs shall be included in the bid. All preventative maintenance and repairs are to be conducted off peak hours. No other charges to the Board shall apply.

66. Traffic/Pedestrian Safety

Vehicles, including Couriers and movable Equipment/Machinery must take all precautions to avoid entering or driving on Board premises during nutritional breaks, before and after school hours, or anytime there are students or staff outside of the building.

67. Traffic Control and Site use

Supplier's activities shall be limited to areas for work and storage as directed by the Board. Except where expressly permitted by the Board, materials and/or equipment must not be stored within four metres of the travelled portion of any roadway. Notwithstanding the foregoing, the Supplier shall, at their own expense, remove any equipment or material, which, in the Board's opinion, constitutes a traffic hazard.

The Supplier shall plan and schedule the routes of vehicles transporting all materials to, from or within the job, so that vehicular movements are accomplished with minimum interference and interruption to traffic. This will necessitate vehicles to "slip off" or "slip on" in the direction of traffic lanes.

The Supplier shall maintain the adjacent side streets in a condition free from debris resulting from their operations, such as materials spilling from trucks. It is expected that the Supplier shall regularly inspect the surface condition of these streets and promptly dispose of all the debris.

Should the Supplier be unable to carry out the required remedial measures, the Board may carry out the necessary maintenance and the costs for the work shall be deducted from payments due to the Supplier.

The Supplier shall, at his own expense and to the satisfaction of the Board, provide all vehicular traffic control equipment, material, and labor required to perform the work in a safe manner in accordance with the "Occupational Health and Safety Act" and the "Ontario Traffic Manual" (Book 7). The Supplier shall assure that all required forms are completed and on-site for inspection. In the event a traffic control company is contracted for the purpose of signage, information regarding the Supplier must be included in the quotation and included with the bid price.

The Supplier shall be responsible for the supply of traffic flag person(s) where required under the "Ontario Traffic Manual" (Book 7), with all costs included in the base unit price.

68. Usage Reports

The Board, at no additional cost, may request detailed usage reports or activity log reports in Excel (unprotected) to be provided annually or upon request. Reports may include but not limited to descriptions, codes, quantities, extended quantity, price.

69. Variation of Bid Prices

No variation in the Total Price, unit prices and/or provisional pricing will be permitted after Closing Time, except in the instance of variation solely due to an increase or decrease in the rate of eligible taxes, beyond the control of the Bidder, occurring after the time of submission of their Bid. An increase or a decrease in the rate of eligible taxes, under these circumstances, shall alter the price of the Bid, but only to the extent of the tax increase or decrease.

70. Volume and Exclusivity

Quantities and/or Board sites may be added, deleted or adjusted at the discretion of the Board due to but not limited to unintentional omissions, inventory adjustments, new schools/school closures and/or budget restraints.

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

contract with other Supplier for good(s) and/or service(s) of the same as or similar to the deliverables or may obtain such good(s) and service(s) internally.

71. Waiver

No term or provision of the Bid Solicitation Document shall be deemed waived, and no breach consented to, unless such waiver or consent is in writing and signed by an authorized representative of the party claimed to have waived or consented to the breach. No consent by a party to, or waiver of, a breach under the procurement process shall constitute consent to, waiver of, or excuse for any other, different, or subsequent breach.

The Board does not accept responsibility for any information or any errors or omissions which may be contained in the Bid Solicitation Document, or the data, materials or documents disclosed or as provided to the Bidders pursuant to the procurement. The Board make no representation or warranty, either expressed or implied, in fact or in law with respect to the accuracy or completeness of the Bid Solicitation Document or such data, materials or documents and the Board shall not be responsible for any actions, costs, losses or liability whatsoever arising from any Bidder's reliance or use of the Bid Solicitation Document or any other technical or historical data, materials or documents provided by the Board. The Bidder is responsible for obtaining its own independent financial, legal, accounting, and technical advice with respect to any information included in the Bid Solicitation Document or in any data, materials, or documents provided or required by the Board.

72. Warranty and Maintenance

The Supplier, 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, unless otherwise stated. Individual sections may extend warranties beyond the two (2) year time frame. The Supplier is responsible for all required maintenance complete with materials and labour during the warranty period.

73. Work Continuity

The Supplier shall take adequate care to protect the Work, the Board's property, adjacent properties and shall be fully responsible for any damage or injury due to their act or neglect or is attributable to the acts or omissions of the Supplier, its Sub-contractors, sub-suppliers, agents, employees, officers, directors, and all other persons and other entities for whose acts the Supplier may be liable or for whom it is responsible in law and their respective officers, directors, agents and employees.

The Supplier shall ensure minimal to no disturbance to the user(s) of the surrounding facilities. Replacement and repairs due to any damage caused to any existing structure, Board equipment, public assets or private property during the Work shall be the responsibility of the Supplier.

74. Work Requirements

The Supplier shall perform entire work with minimal to no disturbance to the routine operations of the respective facility. Further, the Supplier shall ensure safety of WRDSB assets, students, staff as well as public at all times.

75. Workplace Safety Insurance Board (WSIB) Certificate

The Board requires all Suppliers and service providers be in full compliance with all requirements imposed upon them by the Workplace Safety Insurance Board. All certificates of training and Safety Policies and Manuals must be available for presentation upon request.

Prior to a formal award and commencing the services covered by this Bid Solicitation, the recommended Bidder(s) make available to the Board a copy of certificates of good standing with the Workplace Safety and Insurance Board ("WSIB Certificates") listing appropriate NAICS Code and Code Description stating that the Supplier/consultant and all of its sub-contractors/consultants have complied with the requirements of the Workplace Safety and Insurance Act and in particular, that all requisite premiums under such Act have been paid. Where the Bidder is exempt from registration with the WSIB, the Bidder must provide evidence of such by way of written confirmation from WSIB.

WSIB Certificate evidencing renewal or replacement of Certificates listing appropriate NAICS Code and Code Description shall be uploaded through the Bidding System within 72 hours of the expiration or replacement of the current certificate, without demand by the Board.

END OF SECTION

00 73 00 "The Supplementary Conditions"

**SUPPLEMENTARY CONDITIONS & AMENDMENTS TO STANDARD CONSTRUCTION
DOCUMENT CCDC2 -2020 STIPULATED PRICE SUBCONTRACT**

(the "Supplementary Conditions")

**AGREEMENT, DEFINITIONS, AND
GENERAL CONDITIONS**

The Standard Construction Document CCDC 2 2020 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 13 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

ARTICLE A-1 – THE WORK

SC17.1	A-1.3	<u>Amend</u> Article A-1.3 by <u>deleting</u> all of the words after "<i>Contract Documents</i>" and <u>replace</u> them with the following" "attain .1 <i>Substantial Performance of the Work</i> by the 22nd day of August in the year 2025. .2 <i>Ready-for-Takeover</i> by the 28th day of August in the year 2025."
SC1.1		

ARTICLE A-3 – CONTRACT DOCUMENTS

SC2.1	A-3.1	<u>Add</u> the following documents to the list of <i>Contract Documents</i> in Article A-3.1: • Waterloo Region District School Board's Supplementary Conditions & Amendments to Standard Construction Document CCDC 2-2020 Stipulated Price Subcontract, May 2022 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 Act) if applicable • Labour and Material Payment Bond (Form 31 – Labour and Material Payment Bond under Section 85.1 of the Act), if applicable

ARTICLE A-4 – CONTRACT PRICE

SC3.1	A-4.4	<u>Delete</u> Article A-4.4 and <u>replace</u> it with the following: "4.4 The <i>Contract Price</i> shall remain fixed for the duration of the <i>Contract Time</i>, subject only to adjustments as provided for in the <i>Contract Documents</i>. For certainty, and without limiting the general application of the preceding sentence, the <i>Contractor</i> assumes all risks in connection with cost increases for overhead, <i>Products</i>, <i>Labour</i>, and <i>Construction Equipment</i> prescribed by the <i>Contract Documents</i> for the performance of the <i>Work</i>, and the <i>Contractor</i> assumes all responsibility for liabilities and additional costs that may arise as a result of the <i>Contractor's</i> inclusion of any <i>Product</i>, <i>Construction Equipment</i>, <i>Supplier</i>, or <i>Subcontractor</i> in its calculation of the <i>Contract Price</i>."

ARTICLE A-5 – PAYMENT

SC4.1	A-5.1	<u>Delete</u> Article A- 5.1 in its entirety including all subparagraphs and <u>replace</u> it with the following: "5.1 Subject to the provisions of the <i>Contract Documents</i> and the <i>Construction Act</i>, the <i>Owner</i> shall:

		.1 make progress payments to the <i>Contractor</i> on account of the <i>Contract Price</i> when due together with such <i>Value Added Taxes</i> as may be applicable to such payments, .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>Construction Act</i>, there being no claims for lien registered against the title to the <i>Place of the Work</i> and no written notices of lien delivered to the <i>Owner</i>, pay the <i>Contractor</i> the unpaid balance of the 10% 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>. .3 after <i>Ready-for-Takeover</i> has been achieved in accordance with the <i>Contract Documents</i> and the <i>Work</i> is complete, there being no claims for lien registered against the title to the <i>Place of the Work</i> and no written notices of lien delivered to the <i>Owner</i>, pay the <i>Contractor</i> any unpaid balance of the <i>Contract Price</i> in accordance with GC 5.5 – FINAL PAYMENT, excluding <i>Deficiency Holdback</i>, together with such <i>Value Added Taxes</i> as may be applicable to such payment."
SC 4.2	A-5.2.1	<u>Delete</u> subparagraph 5.2.1 in its entirety and <u>replace</u> it with the following: "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."

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

SC3.1	A-9	<u>Add</u> new ARTICLE A-9 CONFLICT OF INTEREST as follows: "ARTICLE A-9 CONFLICT OF INTEREST 9.1 The <i>Contractor</i>, <i>Subcontractors</i> and <i>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. 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>. 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>. 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</i> and <i>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 or Supplier</i> against the <i>Contractor</i>, where the payment to the <i>Subcontractor or 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 claims against the <i>Owner</i> for amounts pertaining to <i>Subcontractor or 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 or Supplier</i> and the <i>Contractor</i> has been found liable for those claims.
	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."

***NEW* ARTICLE A-10 TIME OF THE ESSENCE**

SC6.1	Article A-10	<u>Add</u> the following new Article A-10 as follows: "ARTICLE A-10 TIME OF THE ESSENCE 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, Occupancy</i> (if applicable), and <i>Ready-for-Takeover</i> within the <i>Contract Time</i> stated in Article A-1 of this <i>Contract</i>. 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 <i>Substantial Performance, Occupancy</i> (if applicable), and <i>Ready-for-Takeover</i>. The <i>Contractor</i> agrees that time is of the essence of this <i>Contract</i>." 10.3 The Contractor shall pay to the Owner compensation for all additional costs and damages borne by the Board to cover costs incurred due to delay beyond contract timelines, until Ready-for-Takeover is achieved and certified pursuant to the terms of the Contract. Liquidated damages will be assessed as incurred and amounts will be payable directly to the Board. Additional costs may include, but are not limited to: temporary classrooms, temporary washrooms, additional staff, etc.
SC6.2		

DEFINITIONS

Revisions to Existing Definitions		
SC5.1	Consultant	<u>Amend</u> the definition of "Consultant" by <u>adding</u> the following to the end of the definition: "For the purposes of the <i>Contract</i>, the terms "<i>Consultant</i>", "<i>Architect</i>" and "<i>Engineer</i>" shall be considered synonymous."
SC5.2	Payment Legislation/Construction Act	<u>Delete</u> the Definition of <i>Payment Legislation</i> and replace it with "Construction Act" as follows: "Construction Act <i>Construction 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>Construction Act</i>) commenced on or after October 1, 2019."
SC5.3	Ready-for-Takeover	<u>Amend</u> the Definition of <i>Ready-for-Takeover</i> by deleting all the words after "as verified" and replacing them with "and approved by the <i>Owner</i>."
New Definitions		
	Adjudication	<u>Add</u> the following definition: "Adjudication <i>Adjudication</i> means construction dispute interim adjudication as defined under the <i>Construction Act</i>."
	Close-Out Documentation	<u>Add</u> the following new definition: "Close-Out Documentation <i>Close-Out Documentation</i> has the meaning given to it under GC 5.4.2."
	Confidential Information	<u>Add</u> the following definition: "Confidential Information <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: .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> ."
	Construction Schedule	<u>Add</u> the following definition: "Construction Schedule <i>Construction Schedule</i> means the schedule for the performance of the <i>Work</i> provided by the <i>Contractor</i> , and approved by the <i>Owner</i> , pursuant to GC 3.4.1, including any amendments to the <i>Construction Schedule</i> made pursuant to the <i>Contract Documents</i> ."
	Construction Schedule Update	<u>Add</u> the following definition: "Construction Schedule Update <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: (a) a record version of the updated <i>Construction Schedule</i> in .pdf format; (b) an editable copy of the updated original digital file of the <i>Construction Schedule</i> (e.g., .mpp format files for Microsoft Project)."
	Deficiency Holdback	<u>Add</u> the following definition: Deficiency Holdback - a value applied to the total contract value to cover the cost of completing deficiencies in, or correcting defects in The Work.
	Direct Costs	<u>Add</u> the following definition: "Direct Costs <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."
	EFT	<u>Add</u> the following definition: "EFT <i>EFT</i> has the definition given to it under GC5.3.2."
	Excess Soil	<u>Add</u> the following definition:

		"Excess Soil <i>Excess Soil</i> means "excess soil" as that term is defined under section 3 of the <i>Excess Soil Regulation</i>."
	Excess Soil Regulation	<u>Add</u> the following Definition: "Excess Soil Regulation <i>Excess Soil Regulation</i> means O. Reg. 406/19: On-Site and Excess Soil Management to the <i>Environmental Protection Act</i>, R.S.O. 1990, c. E.19."
	Final Pre-Invoice Submission Meeting	<u>Add</u> the following ne definition: "Final Pre-Invoice Submission Meeting <i>Final Pre-Invoice Submission Meeting</i> has the meaning given to it in GC 5.5.1."
	Force Majeure	<u>Add</u> the following definition: "Force Majeure <i>Force Majeure</i> means any cause, unknown at the effective date of the <i>Contract</i> and beyond either party's control, other than financial difficulties, 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 third-party licences, permits, agreements, or approvals (excluding approvals of any <i>Subcontractors</i> or <i>Suppliers</i> of any tier); civil disturbance; emergency acts, orders, legislation, regulations or directives or revoking of funding from 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)."
	Install	<u>Add</u> the following definition: "Install <i>Install</i> means install and connect. <i>Install</i> has this meaning whether or not the first letter is capitalized."
	Labour Dispute	<u>Add</u> the following definition: "Labour Dispute <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>."
	Notice of Non-Payment	<u>Add</u> the following definition: "Notice of Non-Payment <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."
	OHSA	<u>Add</u> the following definition: "OHSA <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."
	Overhead	<u>Add</u> the following definition: "Overhead <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."
	Payment Period	<u>Add</u> the following definition: "Payment Period <i>Payment Period</i> has the definition given to it under GC 5.2.1."
	Pre-Invoice Submission Meeting	<u>Add</u> the following definition: "Pre-Invoice Submission Meeting <i>Pre-Invoice Submission Meeting</i> has the definition given to it under GC 5.2.1."
	Proper Invoice	<u>Add</u> the following definition: "Proper Invoice <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."
	Proper Invoice Submission Date	<u>Add</u> the following definition: "Proper Invoice Submission Date <i>Proper Invoice Submission Date</i> has the definition given to it under GC 5.2.2.1."
	Request for Information (RFI)	<u>Add</u> the following definition: "Request for Information (RFI) <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> ."

	Restricted Period	<u>Add</u> the following definition: "Restricted Period <i>Restricted Period</i> means the (inclusive) period of time between December 1 to January 8 and August 15 to September 15 of any given year throughout the duration of the <i>Contract</i>."

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

GC 1.1 CONTRACT DOCUMENTS

SC5.1	1.1.3	<u>Delete</u> GC 1.1.3 in its entirety and <u>replace</u> it with the following: "1.1.3 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 GC 3.13.1. Except for its obligation to make such a 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 GC 1.1.3, 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 reasonably have discovered through the exercise of the required standard of care."
SC5.2	1.1.4	<u>Delete</u> GC 1.1.4 in its entirety and <u>replace</u> it with the following: "1.1.4 Except for the obligation to complete the review prescribed in GC 1.1.3, and report the results as set out in this GC 1.1.4, the <i>Contractor</i> is not responsible for errors, omissions or inconsistencies in the <i>Contract Documents</i>. If there are errors, omissions or inconsistencies discovered by or made known to the <i>Contractor</i> as part of its review under GC 1.1.3 or at any time during the performance of the <i>Work</i>, 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 shall not proceed with the <i>Work</i> affected until the <i>Contractor</i> has received corrected or additional information from the <i>Consultant</i>. 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 reasonably have discovered through the exercise of care and skill described in GC 3.13."
	1.1.5.1	<u>Delete</u> GC 1.1.5.1 and <u>replace</u> with the following: "1. the order of priority of documents, from highest to lowest, shall be: .1 Supplementary Conditions; .2 the Agreement between the Owner and the Contractor; .3 the Definitions; .4 the General Conditions; .5 Division 01 of the <i>Specifications</i>

		.6 technical <i>Specifications</i>; .7 material and finishing schedules; and .8 the <i>Drawings</i>.
	1.1.5.5	<u>Delete</u> GC 1.1.5.5 and <u>replace</u> with the following: “.5 Noted materials and annotations on the <i>Drawings</i> shall govern over the graphic representation of the <i>Drawings</i>.”
	1.1.5.6 to 1.1.5.8	<u>Add</u> the following new GC 1.1.5.6 to 1.1.5.8 as follows: “.6 Finishes in the room finish schedules shall govern over those shown on the <i>Drawings</i>. .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. .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.”
	1.1.9	<u>Add</u> the following to the end of GC 1.1.9: “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, outlets and other elements. 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 proceeding with the <i>Work</i>. Where site conditions require reasonable minor changes where the change requires only the additional labour two hours 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>Contract Documents</i>, wherever located and whenever issued, which compile information of similar content and may consist of drawings, tables and/or lists.”
	1.1.13	<u>Add</u> new paragraphs 1.1.13 as follows: 1.1.13 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>.”

GC 1.3 RIGHTS AND REMEDIES

SC6.1	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 6.4.1, 6.5.4, 6.6.1 and 8.3.2, no..."

***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 Contract 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 and further represents and 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> knew about or reasonably ought to have known about prior to the date of the <i>Contract</i>. 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, more onerous to fulfill 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 prior to commencement of the <i>Work</i>, where in tendering for the <i>Work</i> and in entering into this <i>Contract</i>, the <i>Contractor</i> relied 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>, the <i>Contractor</i> shall review to the standard specified in GC 3.14.1, the accuracy of the information furnished by the <i>Owner</i>. If a condition is materially different than what is stated in the information furnished by the <i>Owner</i>, the <i>Contractor</i> shall, no later than five (5) <i>Working Days</i> after the first observation of such condition(s), deliver to the <i>Owner</i> and to the <i>Consultant</i> a <i>Notice in Writing</i> specifying the materially different condition and the <i>Contractor</i> shall not proceed with the affected part of the <i>Work</i> until receiving written direction from the <i>Owner</i> or the <i>Consultant</i>. Where the <i>Contractor</i> fails to provide prompt <i>Notice in Writing</i> in accordance with this GC 1.5.2, the <i>Contractor</i> expressly waives and releases the <i>Owner</i> from all claims with respect to the said information with respect to the <i>Work</i>.

PART 2 ADMINISTRATION OF THE CONTRACT

GC 2.2 ROLE OF THE CONSULTANT

SC11.1	2.2.5	<u>Delete</u> paragraph 2.2.4 and <u>replace</u> it with the following: "2.2.4 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 - PAYMENT, GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK, and GC 5.5 - 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</i>

		<i>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."
	2.2.6	In the first sentence of paragraph 2.2.6, <u>delete</u> the words "Except with respect to GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER".
	2.2.12	At paragraph 2.2.12, <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 2.2.12 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> ."

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.
	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> ."
	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.
	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> ".
	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> ."

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> ".
	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> ."

	2.4.2	<u>Delete</u> paragraph 2.4.2 in its entirety and <u>replace</u> it with the following: "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."
	2.4.4	<u>Add</u> new paragraph 2.4.4 as follows: "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."

PART 3 EXECUTION OF THE WORK

GC 3.1 CONTROL OF THE WORK

SC12.1	3.1.2	Amend paragraph 3.1.2 by <u>inserting</u> the words "Construction Schedule" after the word "sequences".
SC12.2	3.1.3 & 3.1.4	<u>Add</u> new paragraphs 3.1.3 and 3.1.4 as follows: "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> . 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."

GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

SC13.1	3.2.2.1	<u>Delete</u> subparagraph 3.2.2.1 and <u>replace</u> it with "[Intentionally left blank]".
	3.2.3.2	<u>Delete</u> subparagraph 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, including where other contractors or the <i>Owner's</i> own forces are used after the <i>Owner</i> and the <i>Contractor</i> cannot reach agreement on the value of a change, with the <i>Work</i> of the <i>Contractor</i> and connect as specified or shown in the <i>Contract Documents</i> ."
	3.2.3.4	<u>Delete</u> the period at the end of subparagraph 3.2.3.4 and <u>replace</u> it with a semicolon.
	3.2.3.5	<u>Add</u> new subparagraph 3.2.3.5 as follows: ".5 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> ."

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> ".

GC 3.4 CONSTRUCTION SCHEDULE

SC17.1	3.4.1	<u>Delete</u> GC 3.4.1 in its entirety and <u>replace</u> it with the following: "3.4.1 The <i>Contractor</i> shall: 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 original digital file format (e.g., .mpp format for Microsoft Project), portable data file (PDF) format, and hard copy. Once accepted by the <i>Owner</i> and the <i>Consultant</i>, the construction schedule submitted by the <i>Contractor</i> shall become the baseline "Construction Schedule"; .2 provide the expertise and resources, such resources including manpower equipment and tools, 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 3.4 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, .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 3.4 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, .4 if after applying the expertise and resources required under paragraph 3.4.1.2, the <i>Contractor</i> forms the opinion that the slippage in schedule reported in paragraph 3.4.1.3

		cannot be recovered by the <i>Contractor</i>, it shall, in the same notice provided under paragraph 3.4.1.3, 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, .5 ensure that the <i>Contract Price</i> shall include all costs required to phase or stage the <i>Work</i>."
	3.4.2	<u>Add</u> new GC 3.4.2 and GC 3.4.3 as follows: "3.4.2 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 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 GC 3.4.1.3, 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 GC 3.4.1.3, take appropriate steps to cause the actual progress of the <i>Work</i> to conform to the schedule or minimize the resulting delay. Within 5 calendar days of the request by the <i>Owner</i> or the <i>Consultant</i> or the notice being given pursuant to GC 3.4.1.3, 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 recover the performance of the <i>Work</i> to align with the currently approved <i>Construction Schedule</i>. 3.4.3 The <i>Contractor</i> shall not amend the <i>Construction Schedule</i> without the prior written consent of the <i>Owner</i>.. Any revisions to the <i>Construction Schedule</i> approved by the <i>Owner</i> shall not be deemed to be an extension of the <i>Contract Time</i>. All requests by the <i>Contractor</i> for a revision to the <i>Construction Schedule</i> that include an extension to the <i>Contract Time</i> must be approved by the <i>Owner</i> through an executed <i>Change Order</i>."

GC 3.5 SUPERVISION

SC17.1	3.5.1	<u>Delete</u> GC 3.5.1 and <u>replace</u> it with the following: "3.5.1 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 the 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 GC 3.5.1 and other responsible persons who may be contacted for emergency and other reasons during non-working hours. ."
	3.5.2	<u>Delete</u> GC 3.5.2 and <u>replace</u> it with the following: "3.5.2 The superintendent, and any project manager appointed by the <i>Contractor</i>, shall represent the <i>Contractor</i> at the <i>Place of the 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 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> ."
	3.5.3 to 3.5.6	<u>Add</u> new GC 3.5.3, 3.5.4, 3.5.5 and 3.5.6 as follows: "3.5.3 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>. 3.5.4 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. 3.5.5 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>. 3.5.6 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>."

GC 3.6 SUBCONTRACTORS AND SUPPLIERS

SC18.1	3.6.1.1	In paragraph 3.6.1.1 <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> ."
	3.6.1.2	In subparagraph 3.6.1.2 after the words "the <i>Contract Documents</i> " <u>add</u> the words "including any required surety bonding".
	3.6.2	<u>Delete</u> paragraph 3.6.2. in its entirety and <u>replace</u> it with the following: "3.6.2 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."
	3.6.7, 3.6.8, 3.6.9	<u>Add</u> new paragraphs 3.6.7, 3.6.8, 3.6.9, and 3.6.10 as follows: "3.6.7 The <i>Contractor</i> represents and warrants that it has confirmed the availability of its <i>Subcontractors</i> for the <i>Project</i> and, in particular, for the performance of their respective

	&3.6.10	portions of the <i>Work</i> to ensure completion of the <i>Project</i> within the <i>Contract Price</i> and the <i>Contract Time</i>. 3.6.8 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>. 3.6.9 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. 3.6.10 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 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."

GC 3.7 LABOUR AND PRODUCTS

SC19.1	3.7.1	<u>Amend</u> paragraph 3.7.1 by <u>adding</u> the words, "..., agents, <i>Subcontractors</i> and <i>Suppliers</i> ..." after the word "employees" in the first line.
SC19.2	3.7.2	<u>Delete</u> paragraph 3.7.2 and <u>substitute</u> with the following: "3.7.2 <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."
	3.7.4 to 3.7.8	<u>Add</u> new paragraphs 3.7.4, 3.7.5, 3.7.6, 3.7.7, and 3.7.8 as follows: "3.7.4 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. 3.7.5 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> 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>. 3.7.6 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>. 3.7.7 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. 3.7.8 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>."

GC 3.8 SHOP DRAWINGS

SC21.1	3.8.1	<u>Delete</u> paragraph 3.8.1 in its entirety and <u>replace</u> with the following: "3.8.1 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."
	3.8.3	<u>Delete</u> paragraph 3.8.3 and <u>replace</u> it with the following: "3.8.3 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</i>

		<i>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> ."
	3.8.5	<u>Delete</u> paragraph 3.8.5 in its entirety and <u>substitute</u> the following: "3.8.5 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."
	3.8.8 to 3.8.12	<u>Add</u> new paragraphs 3.8.8, 3.8.9, 3.8.10, 3.8.11, and 3.8.12 as follows: "3.8.8 Reviewed <i>Shop Drawings</i> shall not authorize a change in the <i>Contract Price</i> and/or the <i>Contract Time</i> . 3.8.9 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> . 3.8.10 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. 3.8.11 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> . 3.8.12 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."

***NEW* GC 3.9 USE OF THE WORK**

SC22.1	GC 3.9	<u>Add</u> new GC 3.9 – USE OF THE WORK as follows: "GC 3.9 USE OF THE WORK 3.9.1 The <i>Contractor</i> shall confine <i>Construction Equipment</i> , <i>Temporary Work</i> , storage of <i>Products</i> , waste products and debris, and operations of employees and <i>Subcontractors</i> to limits indicated by laws, ordinances, permits, by the direction of the <i>Owner</i> or the <i>Consultant</i> , or the <i>Contract Documents</i> and shall not unreasonably encumber the <i>Place of the Work</i> . 3.9.2 The <i>Contractor</i> shall not load or permit to be loaded any part of the <i>Work</i> with a weight

		or force that will endanger the safety of the <i>Work</i>. 3.9.3 The <i>Owner</i> shall have the right to enter or occupy the <i>Place of the 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> or in any way relieve the <i>Contractor</i> from its responsibility to complete the <i>Contract</i>."

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***NEW* GC 3.10 CUTTING AND REMEDIAL WORK**

SC23.1	GC 3.10	<u>Add</u> new GC 3.10 – CUTTING AND REMEDIAL WORK as follows: "GC 3.10 CUTTING AND REMEDIAL WORK 3.10.1 The <i>Contractor</i> shall perform the cutting and remedial work required to make the affected parts of the <i>Work</i> come together properly. Such cutting and remedial work shall be performed by specialists familiar with the <i>Products</i> affected and shall be performed in a manner to neither damage nor endanger the <i>Work</i>. 3.10.2 The <i>Contractor</i> shall coordinate the <i>Work</i> to ensure all cutting and remedial work required is kept to a minimum. 3.10.3 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>. 3.10.4 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."

***NEW* GC 3.11 CLEAN UP**

SC24.1	3.11.1, 3.11.2, 3.11.3, 3.11.4, 3.11.5 & 3.11.6	Add new paragraphs 3.11.1, 3.11.2, 3.11.3, 3.11.4, 3.11.5, and 3.11.6 as follows: "3.11.1 The <i>Contractor</i> shall maintain the <i>Work</i> in a safe and tidy condition and free from the accumulation of waste products and debris, other than that caused by the <i>Owner</i>, other contractors or their employees. 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>. 3.11.2 Before applying for <i>Substantial Performance of the Work</i>, the <i>Contractor</i> shall remove waste products and debris, other than that resulting from the work of the <i>Owner</i>, other contractors or their employees, and shall leave the <i>Place of the Work</i> clean and suitable for use or occupancy by the <i>Owner</i>. The <i>Contractor</i> shall remove products, tools,

		materials, <i>Construction Equipment</i>, and <i>Temporary Work</i> not required for the performance of the remaining work. 3.11.3 As a condition precedent to submitting its application for final payment, the <i>Contractor</i> shall remove any remaining products, tools, materials, <i>Construction Equipment</i>, <i>Temporary Work</i>, and waste products and debris, other than those resulting from the work of the <i>Owner</i>, other contractors or their employees. 3.11.4 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." 3.11.5 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. 3.11.6 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."

***NEW* GC 3.12 EXCESS SOIL MANAGEMENT**

SC25.1	GC 3.12	<u>Add</u> new GC 3.12 – EXCESS SOIL MANAGEMENT as follows: "GC 3.12 EXCESS SOIL MANAGEMENT 3.12.1 The <i>Contractor</i> shall be solely responsible for the proper management of all <i>Excess Soil</i> at the <i>Place of the Work</i> and for performance of the <i>Work</i> in compliance with the rules, regulations and practices required by the <i>Excess Soil Regulation</i> until such time as <i>Ready-for-Takeover</i> is achieved. Without restricting the generality of the previous sentence, the <i>Contractor's</i> responsibility under this GC 3.12 includes the designation, transportation, tracking, temporary and/or final placement, record keeping, and reporting of all <i>Excess Soil</i> in connection with the <i>Work</i> all in compliance with the <i>Excess Soil Regulation</i>. 3.12.3 The <i>Contractor</i> shall indemnify and save harmless the <i>Owner</i>, their agents, officers, directors, administrators, employees, consultants, successors and assigns from and against the consequences of any and all health and safety infractions committed directly by the <i>Contractor</i>, or those for whom it is responsible at law, under the <i>Excess Soil Regulation</i>, or any environmental protection legislation, including the payment of legal fees and disbursements on a substantial indemnity basis. Such indemnity shall apply to

		the extent to which the <i>Owner</i> is not covered by insurance.”

***NEW* GC 3.13 CONTRACTOR STANDARD OF CARE**

SC25.1	3.13	<u>Add</u> a new GC 3.13 – CONTRACTOR STANDARD OF CARE as follows: “GC 3.13 CONTRACTOR STANDARD OF CARE “3.13.1 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>. 3.13.2 The <i>Contractor</i> further represents, covenants and warrants to the <i>Owner</i> that: .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>.”

PART 4 ALLOWANCES

GC 4.1 CASH ALLOWANCES

SC27.1	4.1.3	In GC 4.1.3 <u>delete</u> the words “through the <i>Consultant</i> ” and <u>replace</u> them with “in writing.”
	4.1.4	<u>Delete</u> GC 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, by the <i>Consultant</i> at the <i>Owner’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>.”

	4.1.7	<u>Delete</u> GC 4.1.7 in its entirety and <u>replace</u> it with the following: "4.1.7 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."
	4.1.8 and 4.1.9	<u>Add</u> new GC 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> 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

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>.

GC 5.2 APPLICATIONS FOR PAYMENT

SC29.1	5.2.1	<u>Delete</u> GC 5.2.1 and <u>replace</u> it with the following: "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: .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; and</i> .3 any other documents reasonably requested, in advance, by the <i>Owner</i> or the <i>Consultant</i>."
SC29.2	5.2.2	<u>Delete</u> GC 5.2.2 in its entirety and <u>replace</u> it with the following: "5.2.2 Applications for payments shall be given in accordance with the following requirements: .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: .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>. .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 email address: facilities_cap@wrdsb.ca .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's</i> obligations to strictly comply with the requirements prescribed in this subparagraph 5.2.2.3. .4 No applications for payment shall be accepted by the <i>Owner</i> prior to the <i>Proper Invoice Submission Date</i>. .5 All applications for payment shall include all of the requirements for a <i>Proper Invoice</i> prescribed by the <i>Construction Act</i> and this <i>Contract</i> and be dated the last day of the applicable <i>Payment Period</i>;"
SC29.3	5.2.3	<u>Delete</u> GC 5.2.3 and <u>replace</u> it with the following: "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's</i> opinion, they are placed and properly secured on the land on which the improvement is made, or placed upon land designated by the <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."
SC29.4	5.2.4	After the word " <i>Consultant</i> " in GC 5.2.4 <u>add</u> the words "and the <i>Owner</i> "
SC29.5	5.2.5	After the word " <i>Consultant</i> " in GC 5.2.5 <u>add</u> the words "or the <i>Owner</i> ".
SC29.6	5.2.9	<u>Add</u> new 5.2.9 as follows: "5.2.9 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."

GC 5.3 PAYMENT

SC30.1	5.3.1	<u>Delete</u> GC 5.3.1 in its entirety, including all subparagraphs thereunder, and <u>replace</u> it with the following: "5.3.1 After receipt by the <i>Owner</i> and the <i>Consultant</i> of an application for payment submitted by the <i>Contractor</i> in accordance with GC 5.2 - APPLICATIONS FOR PAYMENT: .1 the <i>Consultant</i> will either: (a) issue to the <i>Owner</i> with a copy to the <i>Contractor</i>, a progress payment certificate in the amount applied for by the <i>Contractor</i> in the <i>Proper Invoice</i>, or (b) issue to the <i>Owner</i>, with a copy to the <i>Contractor</i>, a certificate for payment for an amount determined by the <i>Consultant</i> to be properly due to the <i>Contractor</i> after applying any credits, withheld amounts, or other set-offs which the <i>Consultant</i> has determined that the <i>Owner</i> is entitled to notwithstanding any notice of dispute or disagreement that the <i>Contractor</i> may have served, along with the <i>Consultant's</i> reasons why an amount other than what is claimed in the <i>Proper Invoice</i> is properly due to the <i>Contractor</i>, which finding the <i>Owner</i> may accept or amend prior to the <i>Owner</i> issuing a <i>Notice of Non-Payment</i>, if any, in accordance with GC 5.3.2; .2 the <i>Owner</i> shall make payment to the <i>Contractor</i> on account as provided in Article A-5 PAYMENT, (a) in the amount stated in the certificate for payment, or

		(b) in the amount stated in the certificate for payment less such amount stated in the <i>Owner's Notice of Non-Payment</i> issued pursuant to GC 5.3.3, on the 28th calendar day after receipt of a <i>Proper Invoice</i>, unless such 28th calendar day lands on a day that is other than a <i>Working Day</i>, in which case payment shall be made on the next <i>Working Day</i> after such 28th day."
5.3.2 to 5.3.7	<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: 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 first application for payment, the <i>Owner</i> and the <i>Contractor</i> shall exchange such information as is necessary to facilitate <i>EFT</i> payments. 5.3.3 In the event that the application for payment delivered by the <i>Contractor</i> pursuant to GC 5.2 - APPLICATIONS FOR PAYMENT does not include the requirements for a <i>Proper Invoice</i> or where the <i>Owner</i> disputes the amount claimed as payable in the <i>Proper Invoice</i>, then the <i>Owner</i> shall within 14 calendar days of receipt of the application for payment, issue a <i>Notice of Non-Payment</i> (Form 1.1). 5.3.4 Where the <i>Owner</i> has delivered a <i>Notice of Non-Payment</i>, the <i>Owner</i> and the <i>Contractor</i> shall first engage in good faith negotiations to resolve the dispute. If within 5 calendar days following the issuance of a <i>Notice of Non-Payment</i>, despite good faith efforts by both parties and the assistance of the <i>Consultant</i>, the <i>Owner</i> and the <i>Contractor</i> cannot resolve the dispute, either party may commence an <i>Adjudication</i> in accordance with the procedures set out in the <i>Construction Act</i>. 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 GC 5.3.1.2. 5.3.5 Provided that the <i>Owner</i> complies with its obligations under the <i>Construction Act</i>, and subject to any interim determination of an adjudicator in accordance with any <i>Adjudication</i>, and where applicable, a final determination made in accordance with the dispute resolution processes prescribed by this <i>Contract</i>, the <i>Owner</i> shall be entitled to claim in a <i>Notice of Non-Payment</i> a right to deduct from or, set off against, any payment of the <i>Contract Price</i>: .1 any amount expended by the <i>Owner</i> in exercising the <i>Owner's</i> rights under this <i>Contract</i> to perform any of the <i>Contractor's</i> obligations that the <i>Contractor</i> has failed to perform; .2 any damages, costs or expenses (including, without limitation, reasonable legal fees and expenses) incurred by the <i>Owner</i> as a result of the failure of the <i>Contractor</i> to perform any of its obligations under the <i>Contract</i>; .3 any other amount owing from the <i>Contractor</i> to the <i>Owner</i> under this <i>Contract</i>.	

		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 RESOLUTION. 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>Construction 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>Construction Act</i> including, without limitation, section 8.1 of the <i>Construction Act</i>. Evidence of the <i>Contractor's</i> compliance under this GC 5.3.7, including evidence demonstrating that all <i>EFTs</i> 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."

GC 5.4

SUBSTANTIAL PERFORMANCE OF THE WORK- AND PAYMENT OF HOLDBACK

SC32.1	GC 5.4	<u>Delete</u> GC 5.4 – SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK in its entirety and <u>replace</u> it with the following: "GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK 5.4.1 When the <i>Contractor</i> considers that <i>Substantial Performance of the Work</i> has been achieved, the <i>Contractor</i> shall prepare and submit to the <i>Consultant</i> and the <i>Owner</i> a comprehensive deficiency list of items to be completed or corrected, including any incomplete <i>Close-Out Documentation</i>, and apply for a review by the <i>Consultant</i> and the <i>Owner</i> to establish <i>Substantial Performance of the Work</i>. Failure to include an item on the list does not alter the responsibility of the <i>Contractor</i> to complete the <i>Contract</i>. 5.4.2 Prior to, or as part of its written application for <i>Substantial Performance of the Work</i> the <i>Contractor</i> shall submit to the <i>Consultant</i> submit to the <i>Consultant</i> all closeout documentation required by the <i>Contract Documents</i>, including but not limited to, warranties, manuals, guarantees, as-built drawings, warranty cards and all other relevant literature from suppliers and manufacturers including, but not limited to, where applicable (the "Close-Out Documentation"): .1 equipment, maintenance, and operations manuals; .2 equipment specifications, data sheets and brochures, parts lists and assembly drawings, performance curves and other related data; .3 line drawings, value charts and control sheets sequences with description of the sequence of operations; .4 warranty documents; .5 guarantees; .6 certificates; .7 service and maintenance reports; .8 <i>Specifications</i>; .9 <i>Shop Drawings</i>;

		.10 coordination drawings; .11 testing and balancing results and reports; .12 <i>Commissioning</i> and quality assurance documentation; .13 distribution system diagrams; .14 spare parts; .15 samples; .16 existing reports and correspondence from authorities having jurisdiction in the <i>Place of the Work</i>; .17 inspection certificates; .18 red-lined record drawings from the construction trailer in two copies and .19 other materials or documentation required to be submitted under the <i>Contract</i>. 5.4.3 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: .1 prepare a final deficiency list incorporating all items to be completed or corrected, including any incomplete or unsubmitted <i>Close-Out Documentation</i>. Each item shall have an indicated value for correction or completion and the determination of the total value of such items shall be determined pursuant to GC 5.8 – 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 the <i>Consultant</i> rendering a determination in accordance with GC 5.4.3.2 .2 having completed the requirements set out in GC 5.4.3.1, (a) 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 (b) 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>. 5.4.4 Following the issuance of the certificate of <i>Substantial Performance of the Work</i> referenced in subparagraph 5.4.3.2(b): .1 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(b) within seven (7) calendar 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; .2 The <i>Contractor</i> shall complete the <i>Work</i> within forty (40) calendar days of the date certified as the date of <i>Substantial Performance of the Work</i>; .3 Notwithstanding any other provisions of the <i>Contract</i>, no payments will be processed between <i>Substantial Performance of the Work</i> and <i>Ready-for-Takeover</i>; .4 The <i>Owner</i> reserves the right to contract out any or all unfinished <i>Work</i> if it has

		not been completed within forty (40) days of <i>Substantial Performance of the Work</i> using, without limitation, the funds retained in accordance with GC 5.8 - DEFICIENCY HOLDBACK, without prejudice to any other right or remedy and without affecting the warranty period. The cost to the <i>Owner</i> 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>. 5.4.5 After publication of the certificate of the <i>Substantial Performance of the Work</i>, and provided that the <i>Contractor</i> has completed performance of the <i>Work</i> within the 40 calendar days following certification of <i>Substantial Performance of the Work</i>, the <i>Contractor</i> may submit an application for payment of the outstanding <i>Construction Act</i> holdback amount, which application for payment shall: .1 include all of the requirements listed in EXHIBIT "1" - PROJECT SPECIFIC REQUIREMENTS FOR A PROPER INVOICE, as applicable to the application for payment of the holdback amount; and .2 include a statement that the <i>Contractor</i> has not received any written notices of lien or any claims for liens from any <i>Subcontractor</i> or <i>Supplier</i>. 5.4.6 The <i>Construction Act</i> holdback amount shall become due and payable the day immediately following the expiration of the holdback period prescribed by the <i>Construction Act</i> (in most cases being the 61st calendar day following the publication of the certificate of <i>Substantial Performance of the Work</i> referred to in GC 5.4.4.1), subject to the occurrence of any of the following: .1 the preservation of a lien in respect of the <i>Project</i> that has not been satisfied, discharged or otherwise provided for in accordance with the <i>Construction Act</i>; .2 receipt by the <i>Owner</i> of a written notice of lien that has not been satisfied, discharged or otherwise provided for in accordance with the <i>Construction Act</i>; or .3 prior to the expiry of 40 calendar days following the publication of the certificate of <i>Substantial Performance of the Work</i>, the <i>Owner</i> publishes a <i>Notice of Non-Payment</i> of holdback in accordance with the <i>Construction Act</i> (Form 6), setting out the amount of holdback that will not be paid, which may include non-payment to secure the correction of deficiencies and/or the completion of the <i>Work</i>. 5.4.7 Notwithstanding the <i>Owner's</i> obligation to make payment of the holdback amount in accordance with GC 5.4.6, the processing of such payment remains subject to the <i>Owner's</i> internal <i>EFT</i> timing limitations. The <i>Owner</i> covenants, and the <i>Contractor</i> agrees, that payment of the holdback shall be made by <i>EFT</i> at the first opportunity during the <i>Owner's</i> normal processing of <i>EFTs</i> upon the holdback becoming due in accordance with GC 5.4.6..

GC 5.5 FINAL PAYMENT

SC35.1	GC 5.5	<u>Delete</u> GC 5.5 in its entirety, including all subparagraphs thereunder and <u>replace</u> it with the following: "5.5.1 When <i>Ready-for-Takeover</i> has been achieved in accordance with GC 12.1 – READY-FOR-TAKEOVER and the <i>Contractor</i> considers the <i>Work</i> is complete, and after the <i>Contractor</i>, the <i>Owner</i>, and the <i>Consultant</i> have attended a <i>Pre-Invoice Submission Meeting</i> analogous to the requirement in GC 5.2.1 (the "<i>Final Pre-Invoice Submission Meeting</i>"), the <i>Contractor</i> may submit an application for final payment to the <i>Owner</i> and to the <i>Consultant</i>, which application for payment shall: .1 include all of the requirements set out in GC 5.2.2, including without limitation those requirements listed in APPENDIX "1" - PROJECT SPECIFIC REQUIREMENTS FOR A PROPER INVOICE that are specific to an application for final payment; and .2 if applicable, (a) a certificate from the <i>Consultant</i> or written confirmation from the <i>Owner</i> that the deficiencies or incomplete <i>Work</i> waived by the <i>Owner</i> pursuant to GC 12.1.2 have been fully rectified as of the date of the <i>Contractor's</i> application for final payment, and/or (b) written confirmation, signed by the <i>Owner</i> and the <i>Contractor</i>, that the <i>Contract Price</i> has been reduced by a specified amount in exchange for the <i>Owner</i> releasing the <i>Contractor</i> of its obligation to rectify the certain outstanding deficiencies and/or incomplete <i>Work</i> waived by the <i>Owner</i> pursuant to GC 12.1.2, as detailed in such written confirmation. 5.5.2 No later than 5 calendar days prior to the <i>Final Pre-Invoice Submission Meeting</i>, the <i>Contractor</i> will, if not already provided, submit to the <i>Consultant</i> all <i>Close-Out Documentation</i>. 5.5.3 Delivery of all <i>Close-Out Documentation</i> is a requirement for the <i>Proper Invoice</i> for final payment. 5.5.4 After receipt by the <i>Owner</i> and the <i>Consultant</i> of an application for payment submitted by the <i>Contractor</i> that is a <i>Proper Invoice</i> and by no later than 10 calendar days after the receipt of the <i>Proper Invoice</i>: .1 the <i>Consultant</i> will either: (a) issue to the <i>Owner</i> with a copy to the <i>Contractor</i>, a progress payment certificate in the amount applied for by the <i>Contractor</i> in the <i>Proper Invoice</i>, or (b) deliver a finding to the <i>Owner</i> with reasons why an amount other than what is claimed in the <i>Proper Invoice</i> is properly due to the <i>Contractor</i>, which finding the <i>Owner</i> may accept or amend prior to issuing a <i>Notice of Non-Payment</i> (Form 1.1), if any, in accordance with GC 5.5.2; .2 the <i>Owner</i> shall make payment to the <i>Contractor</i> on account as provided in Article A-5 PAYMENT,

		(a) in the amount stated in the certificate for payment, or (b) in the amount stated in the certificate for payment less such amount stated in the <i>Owner's Notice of Non-Payment</i> issued pursuant to GC 5.5.5, on the 28th calendar day after receipt of a <i>Proper Invoice</i>, unless such 28th calendar day lands on a day that is other than a <i>Working Day</i>, in which case payment shall be made on the next <i>Working Day</i> after such 28th day.
	5.5.5	In the event that the application for final payment delivered by the <i>Contractor</i> does not include the requirements of GC 5.5.1 (including the requirements for a <i>Proper Invoice</i>) and GC 5.5.2 or where the <i>Owner</i> disputes the amount claimed as payable in the <i>Proper Invoice</i>, then the <i>Owner</i> shall within 14 calendar days of receipt of the application for payment, issue a <i>Notice of Non-Payment</i>. Where the <i>Owner</i> has delivered a <i>Notice of Non-Payment</i>, as specified under this GC 5.5.5, the <i>Owner</i> and the <i>Contractor</i> shall first engage in good faith negotiations to resolve the dispute. If within 5 calendar days following the issuance of a <i>Notice of Non-Payment</i>, despite good faith efforts by both parties with the assistance of the <i>Consultant</i>, the <i>Owner</i> and the <i>Contractor</i> cannot resolve the dispute, either party may commence an <i>Adjudication</i> in accordance with the procedures set out in the <i>Construction Act</i>. 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 GC 5.5.4.2.
	5.5.6	Subject to the provisions of the <i>Construction Act</i> and any other rights conferred on the <i>Owner</i> at law or under this <i>Contract</i> to withhold payment or back charge or set-off against payment, the <i>Owner</i> shall pay the amount payable under a <i>Proper Invoice</i> for final payment in accordance with the <i>Construction Act</i>.
	5.5.7	When the <i>Consultant</i> issues a certificate of completion in accordance with GC 5.5.4.1, the <i>Consultant</i> shall also issue a certificate for release of any holdback for finishing work amount. In accordance with the <i>Construction Act</i>, the <i>Owner</i> may retain any amounts which are required by law to satisfy any liens against the <i>Work</i>, in respect of any third party claims made to the <i>Owner</i> in respect of the <i>Contract</i> or the <i>Work</i>, and in respect of any claims the <i>Owner</i> may have against the <i>Contractor</i>. Subject to the foregoing, the <i>Owner</i> shall release the holdback in accordance with the <i>Construction Act</i>."

GC 5.6 DEFERRED WORK

SC33.1	5.6.1	<u>Delete</u> paragraph 5.6.1 and <u>replace</u> with the following: "5.6.1 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>Construction 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 5.8.1."

***NEW* GC 5.8**

DEFICIENCY HOLDBACK

SC34.1	5.8.1	<u>Add</u> new GC 5.8 – DEFICIENCY HOLDBACK as follows: “GC 5.8 DEFICIENCY HOLDBACK 5.8.1 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 retain a <i>Deficiency Holdback</i>, In addition to the Construction Act holdback. The <i>Deficiency Holdback</i> in the value of 2% shall be applied against the total Contract value and shall be applied to each progress payment. The <i>Deficiency Holdback</i> shall be payable to the Contractor upon the confirmation of completion of all deficiencies and defects in work by the Consultant and the Owner. 5.8.2 In performing the calculation under GC 5.8.1, .1 no individual deficiency will be valued at less than five hundred dollars (\$500.00); and .2 for any <i>Close-Out Documentation</i> not submitted in advance of or as part of the <i>Contractor's</i> application for <i>Substantial Performance of the Work</i>, an amount shall be retained by the <i>Owner</i> as part of the deficiency holdback that is equal to the estimated time and material costs to retain a third-party to re-create the applicable <i>Close-Out Documentation</i>, as determined by the <i>Consultant</i>, until such time as the applicable <i>Close-Out Documentation</i> is submitted and approved. 5.8.3 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> and confirmed to be corrected, there being no claims for lien registered against the title to the <i>Place of the Work</i> issued in accordance with the <i>Construction Act</i>, and less any amounts disputed under an <i>Owner's Notice of Non-Payment</i> (Form 1.1).”

PART 6 CHANGES IN THE WORK

GC 6.1

OWNER'S RIGHT TO MAKE CHANGES

SC37.1	6.1.2	<u>Add</u> the following to the end of GC 6.1.2: “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>, an increase to the <i>Contract Price</i>, or a claim for any extension of the <i>Contract Time</i>.”

	6.1.3 to 6.1.8	<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: “6.1.3 The <i>Contractor</i> agrees that changes resulting from construction coordination, including but not limited to, scheduling, 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 from making any claim for a change in the <i>Contract Price</i> as a result of such changes. 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. 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>. 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>. 6.1.7 Changes to the contract shall be quoted to permit the work to be executed within the <i>Contract Time</i> unless approved by the <i>Consultant</i> and the <i>Owner</i>. 6.1.8 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>. 6.1.9 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.”

GC 6.2 CHANGE ORDER

SC38.1	6.2.1	In paragraph 6.2.1 after the last sentence in the paragraph <u>add</u> the following: “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> ."
	6.2.3 to 6.2.5	<u>Add</u> new paragraphs 6.2.3, 6.2.4, and 6.2.5 as follows: "6.2.3 The value of a change shall be determined in one or more of the following methods as directed by the <i>Consultant</i>: .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: .1 Contractor on work of their own forces, 5% overhead, 5% profit. .2 Subcontractor on work of their own forces, 5% overhead, 5 % profit .3 Contractor on work of Subcontractor, 5% overhead only. 6.2.4 All quotations shall include <i>Direct Costs</i> and be submitted in a complete manner listing: .1 quantity of each material, .2 unit cost of each material, .3 man hours involved, .4 cost per hour, .5 <i>Subcontractor</i> quotations submitted listing items 1 to 4 above and item 6 below. .6 mark-up. 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>."

GC 6.3 CHANGE DIRECTIVE

SC39.1	6.3.6.1	<u>Amend</u> paragraph 6.3.6.1 by deleting the final period and adding the following: "1 Contractors work by their own forces - 5% overhead and 5% profit, Subcontractor work by their own forces – 5% overhead and 5% profit, Contractors on Subcontractors work – 5% overhead only.
	6.3.6.2	<u>Delete</u> paragraph 6.3.6.2 and <u>replace</u> it with the following: ".2 If a change in the <i>Work</i> results in a net decrease in the <i>Contract Price</i>, the amount of the credit shall be the net cost, without deduction for <i>Overhead</i> or profit."

	6.3.7.1(4)	<u>Delete</u> GC 6.3.7.1(4).
	6.3.7.7	Amend GC 6.3.7.7 by <u>deleting</u> the words "described in paragraph 6.3.7.1" and <u>replacing</u> them with "approved by the <i>Owner</i> in writing and in advance of any such expenses being incurred;"
	6.3.7.9	Amend GC 6.3.7.9 by <u>adding</u> the following to the end of the paragraph: "...when specifically requested by the <i>Owner</i> or as directed by the <i>Consultant</i> ;"
	6.3.7.10	Amend GC 6.3.7.10 by <u>adding</u> the following to the end of the paragraph: ", provided that such amounts are not caused by negligent acts, omissions, or default of the <i>Contractor</i> or <i>Subcontractor</i> ;"
	6.3.7.13	<u>Delete</u> GC 6.3.7.13.
	6.3.7.15	<u>Delete</u> GC 6.3.7.15.
	6.3.7.17	<u>Delete</u> GC 6.3.7.17 in its entirety including all subparagraphs.
	6.3.11	<u>Delete</u> GC 6.3.11 and <u>replace</u> it with the following: "6.3.11 The value of the <i>Work</i> performed as a result of a <i>Change Directive</i> shall not be eligible to be included in progress payments until the amount, including the method for determining the amount, of such <i>Change Directive</i> has been determined."

GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

SC40.1	6.4.1	<u>Delete</u> paragraph 6.4.1 in its entirety and <u>replace</u> with the following: "6.4.1.1 Prior to the submission of the bid on which the Contract was awarded, the Contractor confirms that it carefully investigated the Place of the Work insofar as the Place of Work was available for investigation and, in doing so, applied to that investigation the degree of care and skill required by paragraph 3.14.1 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> ."
	6.4.2	<u>Amend</u> paragraph 6.4.2 by <u>adding</u> a new first sentence as follows: "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> and 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."

		-and- <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,".
	6.4.3	<u>Delete</u> paragraph 6.4.3 in its entirety and <u>substitute</u> the following: "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> ."
	6.4.5	<u>Add</u> new paragraph 6.4.5 as follows: "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."

GC 6.5 DELAYS

SC41.1	6.5.1	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)."
	6.5.2	<u>Delete</u> GC 6.5.2 in its entirety and <u>replace</u> it with the following: "6.5.2 If the <i>Contractor</i> is delayed in the performance of the <i>Work</i> by a stop work order issued by a court or other public authority and providing that such order was 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> , <i>Other Contractor(s)</i> , or the <i>Consultant</i> , and relating to the <i>Work</i> or the <i>Place of the Work</i> , then the <i>Contract Time</i> shall be extended for such reasonable time as the <i>Consultant</i> may determine. The <i>Contractor</i> shall be reimbursed by the <i>Owner</i> for 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)."
	6.5.3	<u>Delete</u> paragraph 6.5.3 in its entirety and <u>replace</u> with the following: "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> .”
	6.5.4	<u>Delete</u> paragraph 6.5.4 in its entirety and <u>replace</u> it with the following: “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.”
	6.5.6 to 6.5.8	<u>Add</u> new paragraphs 6.5.6, 6.5.7 and 6.5.8 as follows: “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> . 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. 6.5.8 No claim for delay shall be made by the <i>Contractor</i> 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> ."

PART 7 DEFAULT NOTICE

GC 7.1

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

SC43.1	7.1.2	In GC 7.1.2, <u>delete</u> the words "and if the <i>Consultant</i> has given a written statement to the <i>Owner</i> and <i>Contractor</i> which provides the detail of such neglect to perform the <i>Work</i> properly or such failure to comply with the requirements of the <i>Contract</i> to a substantial degree".
SC43.2	7.1.3.4	<u>Add</u> a new subparagraph 7.1.3.4 as follows: ".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> ."
	7.1.4.1	<u>Delete</u> subparagraph 7.1.4.1 and <u>replace</u> it with the following: ".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> ."
	7.1.4.2	<u>Delete</u> subparagraph 7.1.4.2 and <u>replace</u> it with the following: ".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> ."
	7.1.5.3	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"
	7.1.6 to 7.1.10	<u>Delete</u> GC 7.1.6 and <u>replace</u> it with new paragraphs 7.1.6, 7.1.7, 7.1.8, 7.1.9 and 7.1.10 as follows: "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</i> <i>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. 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</i> <i>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. 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. 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. 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>."

GC 7.2

CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

SC44.1	7.2.2	<u>Delete</u> paragraph 7.2.2 and <u>replace</u> it with the following: "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 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."
SC44.2	7.2.3.1	<u>Delete</u> subparagraph 7.2.3.1 in its entirety.
	7.2.3.2	<u>Delete</u> subparagraph 7.2.3.2 in its entirety.
	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".
	7.2.5	<u>Delete</u> paragraph 7.2.5 and <u>replace</u> it with the following: "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."
	7.2.6 to 7.2.9	<u>Add</u> new paragraphs 7.2.6, 7.2.7, 7.2.8 and 7.2.9 as follows: "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. 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: .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>. 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>. 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>."

PART 8 DISPUTE RESOLUTION

GC 8.1 AUTHORITY OF THE CONSULTANT

SC45.1	8.1.3	<u>Delete</u> paragraph 8.1.3 in its entirety and <u>substitute</u> as follows: "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."

GC 8.2 ADJUDICATION

SC45.2	8.2.2 to	<u>Add</u> new GC 8.2.2, 8.2.3, 8.2.4, 8.2.5, 8.2.6, and 8.2.7 as follows:

	8.2.7	"8.2.2 Save and except where the <i>Contractor</i> has given an undertaking, in accordance with the <i>Act</i>, to refer a dispute to <i>Adjudication</i>, 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 with at least one in-person meeting with the <i>Owner's</i> representative, the <i>Consultant's</i> representative, and the <i>Contractor's</i> representative. The parties agree that such steps will be taken to resolve any disputes in a timely and cost-effective manner. 8.2.3 Notwithstanding any other provisions in PART 8 DISPUTE RESOLUTION, the parties shall engage in <i>Adjudication</i> proceedings as required by, and in accordance with, the <i>Construction Act</i>. 8.2.4 The following procedures shall apply to any <i>Adjudication</i> the parties engage in under the <i>Construction Act</i>: .1 any hearings shall be held at a venue within the jurisdiction of the <i>Place of the Work</i> or such other venue as the parties may agree and which is acceptable to the adjudicator; .2 the <i>Adjudication</i> shall be conducted in English; .3 each party may be represented by counsel throughout an <i>Adjudication</i>; .4 there shall not be any oral communications with respect to issues in dispute that are the subject of an <i>Adjudication</i> between a party and the adjudicator unless it is made in the presence of both parties or their legal representatives; and .5 a copy of all written communications between the adjudicator and a party shall be given to the other party at the same time. 8.2.5 Any documents or information disclosed by the parties during an <i>Adjudication</i> are confidential and the parties shall not use such documents or information for any purpose other than the <i>Adjudication</i> in which they are disclosed and shall not disclose such documents and information to any third party, unless otherwise required by law, save and except the for the adjudicator. 8.2.6 If the <i>Contractor</i> fails to comply with any of the notice requirements set out in the <i>Contract</i>, including the time limits set out in any of the following: .1 GC 6.4 – CONCEALED OR UNKNOWN CONDITIONS; .2 GC 6.5 – DELAYS; .3 GC 6.6 – CLAIMS FOR A CHANGE IN CONTRACT PRICE; .4 PART 8 DISPUTE RESOLUTION .5 GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES .6 GC 9.3 – ARTIFACTS AND FOSSILS; or .7 GC 9.5 - MOULD in respect of any claim or dispute, the <i>Contractor</i> shall have no entitlement whatsoever (including to an increase in the <i>Contract Price</i>, or an extension of <i>Contract Time</i>) in the context of an <i>Adjudication</i> under the <i>Construction Act</i> and waives the right to make any such claims or disputes in an <i>Adjudication</i>. This GC 8.2.6 shall operate conclusively as an estoppel and bar in the event such claims or disputes are brought in an <i>Adjudication</i> and the <i>Owner</i> may rely on this GC 8.2.6 as a complete defence to any such claims or disputes. 8.2.7 The parties hereby acknowledge and agree, .1 that counterclaims, claims of set-off or the exercise or use of other contractual

		rights that permit the <i>Owner</i> to withhold, deduct or retain from monies otherwise owed to the <i>Contractor</i> under the <i>Contract</i> may be referred to, and included as part of, <i>Adjudications</i> under the <i>Construction Act</i>; .2 that disputes related to the termination or abandonment of the <i>Contract</i>, as well as any disputes that arise or are advanced following the termination or abandonment of the <i>Contract</i>, shall not be referred to <i>Adjudication</i> under the <i>Construction Act</i>; .3 that notice(s) of <i>Adjudication</i>, with respect to any dispute or claim relating to the <i>Project</i>, shall not be given, and no <i>Adjudication</i> shall be commenced following <i>Contract</i> completion, <i>Contract</i> abandonment, or termination of the <i>Contract</i>; .4 that any <i>Adjudication</i> between the <i>Contractor</i> and a <i>Subcontractor</i> or a supplier that relates to an <i>Adjudication</i> between the <i>Owner</i> and the <i>Contractor</i> shall be joined together to be adjudicated by a single adjudicator, provided that the adjudicator agrees to do so, and the <i>Contractor</i> shall include a provision in each of its contracts that contain an equivalent obligation to this GC 8.2.7.4; and .5 that, other than where the <i>Contractor</i> is obliged to commence an <i>Adjudication</i> pursuant to an undertaking under the <i>Construction Act</i>, neither the <i>Owner</i> nor the <i>Contractor</i> shall commence an <i>Adjudication</i> during the <i>Restricted Period</i>. 8.2.8 The parties acknowledge and agree that no <i>Adjudication</i>, arbitration, action, suit or other proceeding may be brought by the <i>Contractor</i> against the <i>Owner</i> in respect of a claim for an increase to the <i>Contract Price</i> as set out in GC 6.6, before the <i>Consultant</i> has issued its findings in respect of same, pursuant to GC 6.6.5. For greater clarity and without limiting the foregoing, the amount applied for in each <i>Proper Invoice</i> shall not include any amounts pertaining to the <i>Contractor's</i> claim for an increase in <i>Contract Price</i> unless and until the <i>Consultant</i> has issued a written notice to the <i>Contractor</i> regarding the validity of such claim, as provided for in GC 6.6.5. However, nothing in this GC 8.2.8 shall prevent a <i>Contractor</i> from commencing an <i>Adjudication</i> where, pursuant to the <i>Construction Act</i>, the <i>Contractor</i> is required to give an undertaking to a <i>Subcontractor</i> to commence an <i>Adjudication</i> following delivery of a <i>Notice of Non-Payment</i>."

GC 8.3 NEGOTIATION, MEDIATION AND ARBITRATION

SC46.1	8.3.1	<u>Amend</u> paragraph 8.3.1 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."
	8.3.4	<u>Amend</u> paragraph 8.3.4 by changing part of the second line from "the parties shall request the <i>Project Mediator</i> " to "and subject to paragraph 8.3.1 the parties may request the <i>Project Mediator</i> ".
	8.3.6 to 8.3.9	<u>Delete</u> paragraphs 8.3.6, 8.3.7 and 8.3.8 in their entirety and <u>replace</u> them with the following new GCs 8.3.6, 8.3.7, 8.3.8, and 8.3.9: "8.3.6 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>. 8.3.7 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> .
	8.3.8	Other than where the <i>Contractor</i> is obliged to commence an <i>Adjudication</i> pursuant to an undertaking under the <i>Construction Act</i> , neither the <i>Owner</i> nor the <i>Contractor</i> shall commence an <i>Adjudication</i> during the <i>Restricted Period</i> .
	8.3.9	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>Construction Act</i> and the regulations thereto shall govern the <i>Adjudication</i> ."

PART 9 PROTECTION OF PERSONS AND PROPERTY

GC 9.1 PROTECTION OF WORK AND PROPERTY

SC47.1	9.1.1.1	<u>Delete</u> subparagraph 9.1.1.1 in its entirety and <u>substitute</u> the following: ".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;"
	9.1.2	<u>Delete</u> paragraph 9.1.2 in its entirety and <u>substitute</u> as follows: "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."
	9.1.5	<u>Add</u> new paragraph 9.1.5 as follows: "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."

GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

SC48.1	9.2.1	Amend GC 9.2.1 by <u>inserting</u> the following to the end of the paragraph: "For the purposes of GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES, <i>Excess Soil</i> shall not be considered a 'toxic and hazardous substance'."
SC48.2	9.2.5.5	Add a new subparagraph 9.2.5.5 as follows: ".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."
	9.2.6	<u>Amend</u> GC 9.2.6 by <u>adding</u> the following words after the word "responsible" in the second line: "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,".
	9.2.8	<u>Amend</u> GC 9.2.8 by <u>adding</u> the following words after the word "responsible" in the second line: "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,".
	9.2.10	<u>Add</u> new paragraph 9.2.10 as follows: "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> ."

GC 9.4 CONSTRUCTION SAFETY

SC49.1	9.4.1	<u>Delete</u> GC 9.4.1 in its entirety and <u>replace</u> it with the following: "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> . The <i>Contractor's</i> health and safety program documentation shall be made available for review by the <i>Owner</i> or <i>Consultant</i> immediately upon request. Without limiting the foregoing, the <i>Contractor</i> shall be solely responsible for construction safety in respect of the <i>Consultant</i> , <i>Subcontractors</i> and <i>Suppliers</i> , the <i>Owner's</i> own forces, <i>Other Contractors</i> , and all persons attending the <i>Place</i>

		<i>of the Work during the course of the Project."</i>
	9.4.2	Amend GC 9.4.2 by <u>adding</u> the following words after "and the <i>Contractor</i> ": ", <i>Subcontractors and Suppliers</i> ".
	9.4.3	Amend GC 9.4.3 by <u>adding</u> the following words after "and the <i>Contractor</i> ": ", <i>Subcontractors and Suppliers</i> ".
	9.4.4	<u>Delete</u> GC 9.4.4 and replace it with the following: "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."
	9.4.5	<u>Delete</u> GC 9.4.5 in its entirety and <u>replace</u> it with the following: "9.4.5 Prior to the commencement of the <i>Work</i> , the <i>Contractor</i> shall submit to the <i>Owner</i> : .1 a current WSIB clearance certificate; .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 naming itself as "constructor" under the <i>OHSA</i> ; and .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> ;"
	9.4.6 to 9.4.12	<u>Add</u> new GC 9.4.6, 9.4.7, 9.4.8, 9.4.9, 9.4.10, 9.4.11, and 9.4.12 as follows: "9.4.6 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 <i>OHSA</i> and any other 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 solicitor and client basis. Such indemnity shall apply to the extent to which the <i>Owner</i> is not covered by insurance. 9.4.7 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.

		9.4.8 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>. 9.4.9 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>. 9.4.10 The <i>Contractor</i> shall provide a copy of the safety program described in GC 9.4.9 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. 9.4.11 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 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. 9.4.12 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."."

PART 10 GOVERNING REGULATIONS

GC 10.1 TAXES AND DUTIES

SC50.1	10.1.2	<u>Amend</u> paragraph 10.1.2 by <u>adding</u> the following sentence to the end of the paragraph: "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>."
	10.1.3	<u>Add</u> new paragraph 10.1.3 as follows: "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."

GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

SC51.1	10.2.5	<u>Amend</u> paragraph 10.2.5 by <u>adding</u> the words "Subject to paragraph 3.4" at the beginning of the paragraph. -and- <u>Add</u> the following to the end of the second sentence: "...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>."
	10.2.6	<u>Amend</u> paragraph 10.2.6 by <u>adding</u> the following sentence to the end of the paragraph: "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>."
	10.2.7	<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".
	10.2.8	<u>Add</u> new paragraph 10.2.8 as follows: "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."

GC 10.4 WORKERS' COMPENSATION

SC52.1	10.4.1	<u>Delete</u> paragraph 10.4.1 and <u>replace</u> with the following: "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."

GC 11.1 INSURANCE

SC53.1	11.1	~~Delete~~entirety of GC 11.1 and <u>replace</u> with the following: "GC 11.1 INSURANCE 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. .1 General Liability Insurance 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 \$5,000,000.00 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>Ready-for-Takeover</i>, as set out in the certificate of <i>Ready-for-Takeover</i>, on an ongoing basis for a period of 6 years following <i>Ready-for-Takeover</i>. Where the <i>Contractor</i> maintains a single, blanket policy, the <u>Addition</u> of the <i>Owner</i> and the <i>Consultant</i> is limited to liability arising out of the <i>Project</i> and all operations necessary or incidental thereto. The policy shall be endorsed to provide the <i>Owner</i> with not less than 30 days' notice, in writing, in advance of any cancellation and of change or <u>amendment</u> 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 <i>owned</i> or leased by the <i>Contractor</i>, and endorsed to provide the <i>Owner</i> with not less than 30 days' notice, in writing, in advance of any cancellation, change or <u>amendment</u> restricting coverage. Where the policy has been issued pursuant to a government-operated automobile insurance system, the <i>Contractor</i> shall provide the <i>Owner</i> with confirmation of automobile insurance coverage for all automobiles registered in the name of the <i>Contractor</i>. .3 Aircraft and Watercraft Liability Insurance Intentional Deleted. Not Applicable .4 Property and Boiler and Machinery Insurance (1) Builder's Risk property 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. 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. (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. (3) The policies shall allow for partial or total use or occupancy of the <i>Work</i>. (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. (5) The <i>Contractor</i> shall be entitled to receive from the <i>Owner</i>, in <u>Addition</u> to the amount due under the <i>Contract</i>, the amount at which the <i>Owner's</i> interest in restoration of the <i>Work</i> has been appraised, such amount to be paid as the restoration of the <i>Work</i> proceeds and as provided in GC 5.2 – APPLICATIONS FOR PROGRESS PAYMENT and GC 5.3 – PROGRESS PAYMENT. In <u>Addition</u>, the <i>Contractor</i> shall be entitled to receive from the payments made by the insurer the amount of the <i>Contractor's</i> interest in the restoration of the <i>Work</i>. (6) In the case of loss or damage to the <i>Work</i> arising from the work of other contractors, or the <i>Owner's</i> own forces, the <i>Owner</i>, in accordance with the <i>Owner's</i> obligations under paragraph 3.2.2.4 of GC 3.2 – CONSTRUCTION BY OWNER OR OTHER CONTRACTORS, shall pay the <i>Contractor</i> the cost of restoring the <i>Work</i> as the restoration of the <i>Work</i> 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 <i>Contractor</i> for the performance of the <i>Work</i>, excluding boiler insurance, shall be in a form acceptable to the <i>Owner</i> and shall not allow subrogation claims by the insurer against the <i>Owner</i>. The policies shall be endorsed to provide the <i>Owner</i> with not less than 30 days' notice, in writing, in advance of cancellation, change or <u>amendment</u> restricting coverage. Subject to satisfactory proof of financial capability by the <i>Contractor</i> for self-insurance of his equipment, the <i>Owner</i> agrees to waive the equipment insurance requirement. 11.1.2 The <i>Contractor</i> shall be responsible for deductible amounts under the policies except where such amounts may be excluded from the <i>Contractor's</i> 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 <i>Work</i> is substantially less than the <i>Contract Price</i>, the <i>Owner</i> may reduce the amount of insurance required to waive the course of construction insurance requirement. 11.1.4 If the <i>Contractor</i> fails to provide or maintain insurance as required by the <i>Contract Documents</i>, then the <i>Owner</i> shall have the right to 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>. 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>."

***NEW* GC 11.2 CONTRACT SECURITY**

SC52.1	GC 11.2	<u>Add</u> new GC 11.2 – CONTRACT SECURITY as follows: "GC 11.2 CONTRACT SECURITY 11.2.1 The <i>Contractor</i> shall, prior to the execution of the <i>Contract</i>, furnish a performance bond and labour and material payment bond which meets the requirements under paragraph 11.2.2. 11.2.2 The performance bond and labour and material payment bond shall: .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>Construction 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

		.6 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>. 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. 11.2.4 Without limiting the foregoing in any way, the bonds shall indemnify and hold harmless the <i>Owner</i> for and against costs and expenses (including legal and <i>Consultant</i> services and court costs) arising out of or as a consequence of any default of the <i>Contractor</i> under this <i>Contract</i>. 11.2.4 The <i>Contractor</i> shall be responsible for notifying the surety company of any changes made to the <i>Contract</i> during the course of construction. 11.2.5 The premiums for bonds required by the <i>Contract Documents</i> shall be included in the <i>Contract Price</i>. 11.2.6 Should the <i>Owner</i> require additional bonds by the <i>Contractor</i> or any of his <i>Subcontractors</i>, after thereceipt of bids for the <i>Work</i>, the <i>Contract Price</i> shall be increased by all direct costs attributable to providing such bonds. The <i>Contractor</i> shall promptly provide the <i>Owner</i>, through the <i>Consultant</i>, with any such bonds that may be required."

PART 12 OWNER TAKEOVER

GC 12.1 READY-FOR-TAKEOVER

SC55.1	12.1.1	<u>Delete</u> GC 12.1.1 in its entirety and <u>replace</u> it with the following: "12.1.1 <i>Ready-for-Takeover</i> shall be achieved when all of the following has occurred, as verified and approved by the <i>Owner</i>: .1 <i>Substantial Performance of the Work</i> has been achieved, as certified by the <i>Consultant</i>; .2 a permit for occupancy of the <i>Place of the Work</i> has been obtained from the authorities having jurisdiction; .3 the <i>Work</i> to be performed under the <i>Contract</i> has satisfied the requirements for deemed completion in accordance with Section 2(3) of the <i>Construction Act</i>, .4 final cleaning and waste removal, as required by the <i>Contract Documents</i>; .5 the <i>Contractor</i> has delivered to the <i>Consultant</i> and the <i>Owner</i> all inspection certificates from authorities having jurisdiction with respect to any component of the <i>Work</i> which has been completed; .6 subject only to GC 12.1.2, the entire <i>Work</i> has been completed to the requirements of the <i>Contract Documents</i>, including completion of all items on the punch list prepared at the time of <i>Substantial Performance of the Work</i> and

		the <i>Work</i> is being used for its intended purpose, and is so certified by the <i>Consultant</i>; .7 subject only to GC 12.1.2, the <i>Contractor</i> has submitted to the <i>Owner</i> and the <i>Consultant</i> in a collated and organized matter, all <i>Close-Out Documentation</i> and any other materials or documentation required by the <i>Contract Documents</i>; .8 subject only to GC 12.1.2, all <i>Products</i>, systems and components of the <i>Project</i> have been commissioned and certified for operation and accepted by the <i>Owner</i> and <i>Consultant</i>, and 9 subject only to GC 12.1.2, the <i>Contractor</i> has submitted to the <i>Owner</i> and the <i>Consultant</i> full and complete as-built drawings and <i>Specifications</i> revised by the <i>Contractor</i> to reflect the as-built state of the <i>Work</i>, clearly showing changes to the <i>Drawings</i> and <i>Specifications</i> from the original <i>Contract Documents</i>, all of which have been approved by the <i>Owner</i> acting reasonably."
SC55.2	12.1.2	<u>Delete</u> GC 12.1.2 in its entirety and <u>replace</u> it with the following: "12.1.2 The <i>Owner</i> may, in its sole, absolute, and unfettered discretion, waive compliance with a requirement, or a part thereof, for achieving <i>Ready-for-Takeover</i> set out in GC 12.1.1.6 to 12.1.1.9 (inclusive). Where the <i>Owner</i> exercises the discretion afforded under this GC 12.1.2, the <i>Contractor</i> shall be required to comply with GC 5.5.1.2 as part of its application for final payment and the <i>Owner</i> and the <i>Contractor</i>, in consultation with the <i>Consultant</i>, shall establish a reasonable date for completing the <i>Work</i>."
SC55.3	12.1.3	<u>Delete</u> GC 12.1.3 in its entirety and <u>replace</u> it with the following: "12.1.3 When the <i>Contractor</i> considers the <i>Work Ready-for-Takeover</i>, it shall submit a written application to the <i>Owner</i> and the <i>Consultant</i> for review."
SC55.4	12.1.4	In GC 12.1.4, <u>delete</u> the words "list and" from the second line.
SC55.5	12.1.5	<u>Delete</u> GC 12.1.5 in its entirety and <u>replace</u> it with the following: "12.1.5 Following the confirmation of the date of <i>Ready-for-Takeover</i> by the <i>Consultant</i> and as confirmed by the <i>Owner</i>, the <i>Contractor</i> may submit a final application for payment in accordance with GC 5.5 – FINAL PAYMENT."
SC55.6	12.1.6	<u>Delete</u> GC 12.1.6 in its entirety.

GC 12.2 EARLY OCCUPANCY

SC56.1	GC 12.2	<u>Delete</u> GC 12.2 – EARLY OCCUPANCY BY THE OWNER in its entirety, including all subparagraphs thereunder and <u>replace</u> it with the following: "12.2.1 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 have reached Substantial Performance of the <i>Work</i>. Where the <i>Work</i> extends beyond the <i>Contract Time</i>, progress and completion of the <i>Work</i> shall not unduly interfere with the delivery of scheduled school programs. The taking of possession or

		use of any such portion of the Project shall not be deemed to be the Owner's acknowledgement or acceptance of the Work or Project nor shall it relieve the Contractor of any of its obligations under the Contract. 12.2.2 Whether the Project contemplates Work by way of renovations in buildings which will be in use or be occupied during the course of the Work or where the Project involves Work that is adjacent to a structure which is in use or is occupied, the Contractor, without in any way limiting its responsibilities under this Contract, shall take all reasonable steps to avoid interference with fire exits, building access and egress, continuity of electric power and all other utilities, to suppress dust and noise 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."

GC 12.3 WARRANTY

SC57.1	12.3.1	<u>Delete</u> from the first line of paragraph 12.3.1 the words "one year" and <u>replace</u> it with the words "two years"
	12.3.2	<u>Delete</u> from the first line of paragraph 12.3.2 the word "The" and <u>replace</u> it with the words "Subject to GC 1.1.3, the..."
	12.3.7 to 12.3.12	<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. 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: .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 "<i>Ready-for-Takeover</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>. 12.3.9 Should any <i>Work</i> need to 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. 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>. 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>. 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 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."

PART 13 INDEMNIFICATION AND WAIVER

GC 13.1 INDEMNIFICATION

SC58.1	GC 13.1	<u>Delete</u> GC 13.1 – INDEMNIFICATION in its entirety and <u>replace</u> it with the following: "13.1.1 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). 13.1.2 The <i>Owner</i> shall indemnify and hold the <i>Contractor</i>, its agents and employees harmless from and against claims, demands, losses, costs, damages, actions, suits or proceedings arising out of the <i>Contractor's</i> performance of the <i>Contract</i> which are attributable to a lack of or defect in title or an alleged lack of or defect in title to the <i>Place of the Work</i>. 13.1.3 The provisions of GC 13.1 - 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 13.1 13.1.4 Notwithstanding the provisions of GC1.1 - CONTRACT DOCUMENTS, GC 1.1.6, GC13.1 -

		INDEMNIFICATION shall govern over the provisions of GC 1.3.1 of GC1.3 – RIGHTS AND REMEDIES.”

GC 13.2 WAIVER OF CLAIMS

	13.2.1	In paragraph 13.2.1 in the third line after the word “limitation” <u>add</u> the words “claims for delay pursuant to GC 6.5 DELAYS” -and- <u>add</u> the words “(collectively “ Claims ”)” after “ <i>Ready-for-Takeover</i> ” in the fourth line.
	13.2.1.1	In subparagraph 13.2.1.1, in each instance change the word “claims” to “Claims” and change the word “claim” to “Claim”.
	13.2.1.2	In subparagraph 13.2.1.2 change the word “claims” to “Claims”.
	13.2.1.3	<u>Delete</u> subparagraph 13.2.1.3 in its entirety.
	13.2.1.4	In paragraph 13.2.1.4 change the word “claims” to “Claims”.
	13.2.2.1	In paragraph 13.2.2.1 <u>delete</u> the words “in paragraphs 13.2.1.2 and 13.2.1.3” and <u>replace</u> them with “in paragraph 13.2.1.2” -and- change the word “claims” to “Claims” in both instances and change the word “claim” to “Claim”.
	13.2.3	<u>Delete</u> paragraph 13.2.3 in its entirety.
	13.2.4	<u>Delete</u> paragraph 13.2.4 in its entirety.
	13.2.5	<u>Delete</u> paragraph 13.2.5 in its entirety.
	13.2.6	In paragraph 13.2.6 change the word “claim” to “Claim” in all instances in the paragraph.
	13.2.8	In paragraph 13.2.8 change “The party” to “The <i>Contractor</i> ” -and- change the word “claim” to “Claim” in all instances in the paragraph.
	13.2.9	In paragraph 13.2.9 <u>delete</u> the words “under paragraphs 13.2.1 or 13.2.3” and <u>replace</u> them with “under paragraph 13.2.1”

		-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.

***NEW* PART 14 OTHER PROVISIONS**

SC58.1	14.1	<u>Add</u> new PART 14 – OTHER PROVISIONS as follows: "PART 14 OTHER PROVISIONS GC 14.1 OWNERSHIP OF MATERIALS 14.1.1 Unless otherwise specified, all materials existing at the <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>."
	14.2	<u>Add</u> new GC 14.2 – CONSTRUCTION LIENS as follows: "GC 14.2 LIENS 14.2.1 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: .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. 14.2.2 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: .1 within 10 calendar days of registration of the construction lien, vacate or discharge the lien from title to the premises (i.e. the <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;

		.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 .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. 14.2.3 In the event that the <i>Contractor</i> fails or refuses to comply with its obligations pursuant to paragraph 14.2.2, 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>. 14.2.4 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. 14.2.5 Nothing in this GC 14.2 serves to preclude the <i>Contractor</i> from preserving and perfecting its lien in the event of non-payment by the <i>Owner</i>."

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 –PAYMENTS for progress payments, GC 5.4 – SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK GC 5.5 – 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 5.2.4, 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 *Close-Out Documentation*, 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 3.11.

END OF AMENDMENTSTO CCDC 2 - 2020

DIVISION 01 - GENERAL REQUIREMENTS

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 the course of work.
 - .1 Keep duration of interruptions minimum.
 - .2 Perform interruptions after normal working hours of occupants, preferably on weekends.
- .2 Provide for vehicular, pedestrian and personnel traffic.
- .3 Construct barriers in accordance with Section 01 53 00.

1.2. 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 the 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.

1.3. SPECIAL REQUIREMENTS

- .1 Schedule and perform work in occupied areas to the Board Representative's approval.
- .2 Schedule and perform noise generating work to the 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

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 contractor'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

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:

1	Designated Substance Removal. (Additional removal not already identified in the ACM Summary report)	\$4,000
2	Flaking Lead Paint removal at underside of Roof GWB	\$10,000
3	Independent Testing & Inspection	\$10,000
4	Window coverings	\$15,000
5	Data and Phone Systems (including terminations)	\$20,000
6	Projectors and Sound Field Systems	\$80,000
7	Custom Return Air Grilles	\$3,500
8	Finish Hardware	\$7,500
8	Signage	\$5,000
Total of All Allowances:		\$155,000

END OF 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 Coordinate 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. PRE-CONSTRUCTION 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 shutdown procedures
 - .18 Any other items as required by the 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 the 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 the 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

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

01 33 00 – Submittal Procedures

1.0 GENERAL

1.1 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.

1.1 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.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "Shop Drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 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.

1.3 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.

1.4 MOCK-UP

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

1.5 ` 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

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.
- .6 Appendix 01 35 17A Contractor Hot Work Permit

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 the 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 attached Appendix 01 35 17-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 the date of expiration.
- .6 The most current version of the Permit and its requirements shall be used for the purposes of the Work.

1.6. FIRE PROTECTION SYSTEMS

- .1 Any Modifications to Fire Alarm system and its 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 with CSA regulations. Certificate of Verification is required before occupancy.

1.7. FIRE ALARM SHUT-DOWN PROCEDURE

- .1 Plan the operation such that the required work minimizes system down time to the least amount possible. Do not shut the system down or engage silence mode when the building is occupied by students. Only shut the system down when necessary.
- .2 For the purposes of this section, unoccupied shall mean when the school is not occupied by students.
- .3 Wherever possible, shut down only the zone needing work,
- .4 and schedule down time in unoccupied school hours.
- .5 Contractor(s) shall ensure all costs are included in their bid price for work related to the fire alarm system outside of regular hours and/or during unoccupied school hours. This shall include evening and weekend work.
- .6 A fire alarm system must remain active when the building is not occupied by school or contractor's forces and should never be offline overnight.
- .7 Procedure
The following procedure shall be followed when a fire alarm system is completely or partially affected by maintenance, shutdown, bypass, silence, loss of power, or any other nomenclature that affects the proper operation of the complete system.
 - .1 Inform both the principal and head custodian whenever the fire alarm system is to be disabled prior to any partial or whole system shut down.

- Where school staff are not available, ensure that the Project Coordinator and/or area supervisor are informed.
- .2 Ensure that the school or building administration has advised all staff when the fire alarm system is disabled and/or when it is back online. This will include instructions to call 911 if they detect smoke or a fire.
 - .3 Immediately prior to alarm system shutdown and upon restoring the fire alarm system, the person supervising the shutdown must:
 - 1.7.7.1.3.1. obtain the school account number, located on a red decal attached to the fire alarm panel. This number will be formatted as 20-9xxx, with the xxx being the school location code,
 - 1.7.7.1.3.2. contact Direct Detect at 519-741-2494 (the fire alarm monitoring company), to inform them of the state of the fire alarm and the approximate amount of time the fire alarm will be offline. They will require the building name and account number, the contact name, the contractor name as well as any other information they request, and
 - 1.7.7.1.3.3. contact Bestell at 519-741-2494 (the current security monitoring company), to inform them of the state of the fire alarm and the approximate amount of time the fire alarm will be offline. They may require the building name and account number as well as any other information they request.
 - .4 A fire watch, at the Contractor's expense, shall be undertaken by a person with the sole and express purpose of completing the following tasks and in the event of the detection of smoke, fire, or any other emergency, notifying the fire department, and the building occupants. The fire watch patrol shall:
 - 1.7.7.1.4.1. patrol all halls and high-risk areas affected,
 - 1.7.7.1.4.2. have access to a phone and call 911 if they see or detect smoke or fire,
 - 1.7.7.1.4.3. report any other problems they encounter,
 - 1.7.7.1.4.4. notifying the building occupants in the event of an emergency and
 - 1.7.7.1.4.5. remain on patrol until the fire alarm system is reactivated and fully operational.
 - .5 Contact Direct Detect, Bestell, and school administration to inform them that the fire alarm is back online.

- .6 In the event that a fire alarm system is activated, whether by smoke, fire or accidentally, the system must not be reset until authorized by the Fire Department (verbally or in person) 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 online
- .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 subcontractor 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 the 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 put in 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 subcontractors 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 the 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. The 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 flashpoint 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

Appendix - 013517-A

CONTRACTOR HOT WORK PERMIT

Avoid hot work or seek an alternative method if possible.

A SEPARATE PERMIT IS REQUIRED FOR EACH AREA

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

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

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)		

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 each day, the precautions listed in Section A have been taken each day, and permission is authorized for this work.

I further acknowledge that if activity is during school operational hours, that appropriate notification has been given to school administration.

Hot Works Contractor: _____

Signature

School Administrator notified: _____

Print Name

In Case of Emergency call: 911 - Then call: 519-570-0003 Ext. 4123

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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. The Health and Safety Plan must address project specifications.
- .2 Consultant may respond in writing, where deficiencies or concerns are noted and may request resubmission 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 the 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, the person responsible for design, or their representative, shall inspect the structure and certify it has been constructed according to their design.

1.5. RESPONSIBILITY

- .1 The "Prime Contractor" according to 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 the 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 subcontractors.

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 the 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 the 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 devices.

1.15. OVERHEAD LIFTING

- .1 Under no circumstances will a crane or lifting device be used over an 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

01 35 43 – Hazardous Materials

1.0 GENERAL

1.1. 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.

1.2. REFERENCES

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

1.3. 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.

1.4. 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 from 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 contractor 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.

1.5. 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 contractor 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 contractor 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

1.6. 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

Appendix 01 35 43A Asbestos Audit Report

PROJECT-SPECIFIC DESIGNATED SUBSTANCE & HAZARDOUS MATERIALS ASSESSMENT

St Andrew's Senior Public School
65 Victoria Avenue,
Cambridge, Ontario

Prepared for:
Jeff Cull,
Environmental Officer – Facility Services

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

Prepared by:
Safetech Environmental Limited



Per: Alyssa Nagy, B.Sc.,
Occupational Health & Safety Technician



Per: Shannon Deline, B.A.,
Project Coordinator



Reviewed by: Jeremy J. Gore, C.E.T., EP
Regional Manager – SWO

Safetech Project Number 2-3250001

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EXECUTIVE SUMMARY

Safetech Environmental Limited (Safetech) was retained by Jeff Cull with the Waterloo Region District School Board (WRDSB), to conduct a project-specific designated substance and hazardous materials (DSHM) assessment in preparation of upcoming renovation work within St Andrew's Senior Public School located at 65 Victoria Avenue, in Cambridge, Ontario. The building will herein be referred to as the "site".

The objective of our assessment was to determine the presence, location, condition, and approximate quantities (where possible) of designated substances and other hazardous materials within project-specific assessment areas that have the potential to be disturbed as part of upcoming renovation activities so that appropriate abatement and other control measures can be implemented to protect workers during work and control/classify waste materials, as mandated by Ontario regulations. It is Safetech's understanding that the proposed renovation work includes various interior floor, ceiling, wall, lighting and millwork upgrades within project-specific work areas as identified by marked-up floor plans provided by the Waterloo Region District School Board.

A summary of the designated substances and hazardous materials identified is provided below. This should be considered a summary only. Please refer to the Results (Section 3) and Conclusions and Recommendations (Section 4) of our report for additional details.

Asbestos

Asbestos was confirmed present within the following building materials observed within project-specific assessment areas:

- Beige pebble patterned vinyl sheet flooring in ground floor corridors 902 and 807;
- Silver acoustic coating on the underside of the sink within room 108; and,
- Gold acoustic coating on the underside of the sink within room 305.

No other asbestos-containing materials were identified or are suspected present within the project-specific assessment areas. This assessment was limited to sampling of materials that have the potential to be impacted by planned renovation work, as reported by the WRDSB. Assessment of other areas or materials within the building was not conducted. Asbestos-containing materials and other designated substances are present in other areas of the building, which are not identified in this report. If the scope of work expands beyond the limit of our assessment then stop work immediately and assess, as needed. Refer to Figures AS01 through AS03 in Appendix B for the extent of this assessment.

Lead

Green paint on interior concrete block walls was determined to contain between 1000 µg/g and 5,000 µg/g of lead, and is considered 'lead-containing' by definition of the Environmental Abatement Council of Canada (EACC) Lead Guideline for Construction, Renovation, Maintenance or Repair.

Lead is also suspected present in minor quantities as solder in pipe fittings and electrical equipment, in lead-acid batteries of emergency light fixtures, and in ceramic tile glazing. Any disturbance of lead-containing paints and/or lead materials should be conducted in accordance with the procedures outlined in the EACC "Lead Guideline" (October 2014) and the Ministry of Labour, Immigration, Training and Skills Development (MLITSD) "Lead on Construction Projects" guideline (April 2011). The extent of procedures required depends on the type of work to be conducted.

Mercury

Mercury is deemed present in the form of mercury vapour within sealed fluorescent lamps. Lamps should be handled with care and kept intact to avoid potential exposure to mercury. R.R.O 1990 Regulation 347, waste mercury produced in amounts less than 5 kilograms (kg) are exempt from hazardous waste registration, treatment and disposal requirements and can be disposed of in landfill as regular waste.

Silica

Silica is deemed present in drywall and associated joint compounds, plaster finishes, lay-in acoustic ceiling tiles, texture finishes, caulking, mastics, ceramic tiles and grout, block and associated mortar, and all concrete materials and finishes. Work involving the disturbance of silica-containing materials should follow the procedures outlined in the MLITSD "Silica on Construction Projects" Guideline (April 2011). The appropriate engineering controls, work practices, hygiene practices, personal protective measures and training necessary to conduct the work in a safe manner are provided in this guideline.

This assessment satisfies the Owner's requirements under Section 30 of the Ontario Occupational Health and Safety Act (OHSA), Revised Statutes of Ontario 1990, as amended.

Should you have any questions regarding the information contained in the report, please contact our office at 519.954.2732.

Safetech Environmental Limited

A handwritten signature in black ink, appearing to read 'Alyssa'.

Per: Alyssa Nagy, B.Sc.,
Occupational Health & Safety Technician
anagy@safetechenv.com

A handwritten signature in black ink, appearing to read 'Shannon Deline'.

Per: Shannon Deline, B.A.
Project Coordinator
sdeline@safetechenv.com

A handwritten signature in black ink, appearing to read 'Jeremy J. Gore'.

Reviewer: Jeremy J. Gore, C.E.T., EP
Regional Manager – SWO
jgore@safetechenv.com

January 29, 2025

Waterloo Region District School Board

51 Ardelt Avenue
Kitchener, Ontario N2C 2R5

Attention: Jeff Cull,
Environmental Officer – Facility Services
Jeff_cull@wrdsb.ca

**RE: Project-Specific Designated Substance & Hazardous Materials Assessment
St. Andrews Senior Public School
65 Victoria Avenue, Cambridge, Ontario**

1.0 INTRODUCTION

1.1 Background and Objectives

Safetech Environmental Limited (Safetech) was retained by Jeff Cull with the Waterloo Region District School Board (WRDSB), to conduct a project-specific designated substance and hazardous materials (DSHM) assessment in preparation of upcoming renovation work within St. Andrews Senior Public School located at 65 Victoria Avenue, in Cambridge, Ontario (site). The objective of our assessment was to determine the presence, location, condition and approximate quantities of designated substances and other hazardous materials within project-specific assessment areas that have the potential to be disturbed as part of upcoming renovation activities so that appropriate abatement and other control measures can be implemented to protect workers during work and control/classify waste materials, as mandated by Ontario regulations.

This assessment satisfies the requirements under Section 30 of the Ontario Occupational Health and Safety Act (OHSA), Revised Statutes of Ontario 1990, as amended. Section 30(1) requires an assessment to determine if there are any designated substances present at a project site prior to construction or demolition activity. Sections 30(2), (3) and (4) require the constructor for a project to provide the findings in this report as part of the tendering information for any tendered project or to prospective contractors (and subcontractors) of a project before entering into a binding contract.

This report documents the findings of our on-site inspection that was conducted on January 7, 2025, and provides conclusions and recommendations based on our findings and knowledge of the planned renovation project.

1.2 Scope of Work

Our scope of work included the following activities:

- A review of existing environmental assessment report(s) provided by Jeff Cull of the WRDSB.
- A visual assessment of all project areas specific to the renovation project to identify the presence, location, condition and approximate quantities of designated substances and other hazardous building materials that may be present. The extent of our assessment area was defined by marked-up floor plans provided by the WRDSB on December 16, 2024.
- Collection, analysis and interpretation of representative bulk samples of suspect asbestos-containing building materials for the determination of asbestos content and material classification (limited to the project-specific assessment areas) only where deemed necessary if a data gap was identified by past environmental reports or a material was noted that does not match a reported description.
- Collection, analysis and interpretation of representative paint chip samples of suspect lead-containing paint for the determination of lead content and material classification (limited to the project-specific assessment areas).
- Preparation of a report to document findings and provide recommendations regarding control measures and/or special handling procedures for designated substances or specific hazardous materials that may be removed or disturbed as part of planned demolition activities.

This assessment only identified designated substances and hazardous materials that were deemed to be part of the building or somehow otherwise incorporated into the building structure and its finishes. Assessing occupant items such as stored products, furnishings, and items, etc., were beyond the scope of this assessment. In addition, our assessment did not include an investigation for underground materials or equipment (vessels, drums, underground storage tanks, pipes, cables, etc.). Furthermore, this assessment was limited to the areas investigated, and more specifically, to those materials that are readily accessible without demolition or alteration of building components for access.

1.3 Past Environmental Reports

Data from past environmental surveys was referenced in terms of understanding previous assessment results and obtaining a general understanding of the overall asbestos-containing material conditions. Where possible, Safetech relied upon results indicated in past surveys and only collected confirmatory samples as necessary.

The following environmental report was provided to Safetech:

- ‘2024 Asbestos Audit Update Report – St. Andrews Public School, 65 Victoria Avenue, Cambridge, Ontario’ completed by MTE Consultants, dated January 16, 2024.

Based on our review of the previous asbestos reassessment report, the following asbestos-containing materials are present within the project-specific work areas:

- Beige pebble patterned vinyl sheet flooring.

2.0 METHODOLOGY

The presence of hazardous materials was assessed by visual inspection. For the purpose of this assessment and this document, hazardous materials include designated substances as well as other chemical, biological and environmental hazards as defined below:

- **Designated Substances (as prescribed by Ontario Regulation 490/09):**
 - Acrylonitrile, Arsenic, Asbestos, Benzene, Coke Oven Emissions, Ethylene Oxide, Isocyanates, Lead, Mercury, Silica and Vinyl Chloride.
- **Other Hazardous Materials:**
 - **Chemical Hazards** – Urea Formaldehyde Foam Insulation (UFFI) and other obvious potential chemical hazards
 - **Biological Hazards** – Mould Contamination
 - **Environmental Hazards** – Polychlorinated Biphenyls (PCBs) and Ozone Depleting & Global Warming Substances

For background information regarding the above hazardous materials, please refer to Appendix E.

Destructive testing was not conducted as part of this assessment. Concealed locations such as above solid ceilings, within wall cavities, enclosed mechanical/pipe shafts and bulkheads, etc. were not investigated. Similarly, motors, blowers, electrical panels, etc., were not de-energized or disassembled to examine concealed conditions. Building materials that are not detailed within this assessment due to inaccessibility at the time of our site visit and/or uncovered during renovation activities should be assessed by a qualified person prior to their disturbance.

Bulk sampling followed by laboratory analysis was also conducted to confirm the presence/absence of selected hazardous materials. Bulk sampling was limited to asbestos in building materials and lead in paint. All other hazardous materials were identified by visual inspection only.

Where possible, observations regarding the location, quantity and condition of the hazardous materials identified were made in order to determine the potential for exposure and provide appropriate recommendations for remedial action, if necessary. Specific methodology for each individual hazardous material assessed is further detailed below.

2.1 Designated Substances

2.1.1 Asbestos

A visual inspection for the presence of both friable and non-friable asbestos-containing material (ACM) was performed within the assessment area. The condition of ACM was rated as Good, Fair or Poor based on our assessment criteria provided in Appendix A.

Although destructive testing was not conducted, details regarding the possible presence of ACM in enclosed locations were provided on a case-by-case basis where our visual inspection indicated this possibility. Materials that may be present in the surveyed area(s) that were not tested intrusively should be considered asbestos-containing until proven otherwise. This includes materials such as elevator brakes, roofing felts, mastics, high voltage wiring, mechanical packing and gaskets, vermiculite inside wall cavities or inaccessible ceiling spaces, and underground services or piping. These materials are recommended to be sampled immediately prior to renovation work if they are to be removed or have a potential to be disturbed.

Bulk samples of building materials were retrieved for all accessible building materials within the investigated areas that were suspected to be asbestos-containing, based on the historical use of the material and surveyor knowledge and experience. Bulk samples were retrieved in accordance with Section 3 and Table 1 of Ontario Regulation 278/05, *Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations (O. Reg. 278/05)*, made under the Occupational Health and Safety Act. The number of samples collected for each material was based on the type and quantity of the material present within the area(s) investigated.

Each individual sample was placed in a labelled, sealable, plastic bag for transportation to an independent laboratory (EMC Scientific Inc.). EMC Scientific Inc. is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for bulk asbestos fibre analysis.

Analysis for asbestos content was performed by the independent laboratory in accordance with the U.S. Environmental Protection Agency (EPA) Test Method EPA/600/R-93-116: Method for the Determination of Asbestos in Bulk Building Materials. June 1993. This method identifies the asbestos fibre content of building materials using polarized light microscopy (PLM) analytical techniques, with confirmation of presence and type of asbestos made by dispersion staining optical microscopy. This analytical method meets the requirements set forth in Section 3 of O. Reg. 278/05.

In accordance with O. Reg. 278/05, an asbestos-containing material is defined as material that contains 0.5 per cent or more asbestos by dry weight. The laboratory was instructed to conduct “stop-positive” analysis for all materials. If a sample was found to be asbestos-containing no further analysis was conducted for samples taken from the same homogeneous material. The Laboratory Certificate of Analysis is included in Appendix C. Locations where ACM have been identified are detailed in this report. Recommendations pertaining to ACM were made based on the friability, accessibility, and condition of the material.

2.1.2 Lead

An assessment for lead in paint was conducted by retrieving paint chip samples from representative surfaces within the areas assessed. The condition of the painted surface from which each sample was taken was also visually assessed for signs of deterioration such as cracking, chipping, flaking, bubbling and deterioration due to friction. The condition of these surfaces were assessed as good, fair or poor based on the degree and extent of deterioration. The paint chip sample was retrieved by scraping the paint down to the base material substrate to ensure collection of all layers of paint. Care was taken to avoid collection of the underlying substrate to reduce analytical substrate matrix interference.

Upon completion of our assessment, the paint chip samples were submitted to an independent laboratory (Caduceon Environmental Laboratories) for the determination of lead content. This laboratory participates in and is accredited by the EPA (U.S. Environmental Protection Agency) for analysis of lead in paint chips through the American Industrial Hygiene Association (AIHA) Environmental Lead Laboratory Accreditation Program (ELLAP). Analysis was conducted by the laboratory following the EPA Method 6010. Result of analysis was reported by the laboratory in micrograms per gram ($\mu\text{g/g}$). The Laboratory Certificate of Analysis is included in Appendix C.

The presence of lead in other materials, such as lead sheeting, pigmented mortar, lead piping, lead solder, etc. were noted where observed but were not sampled to verify lead content. Lead can be present in these materials to varying degrees, depending on their age of application (refer to Appendix E for additional details) and should be considered lead-containing until proven otherwise.

2.1.3 Mercury

The type, quantity, and location of mercury-containing equipment and devices within the areas assessed were determined by visual inspection based on appearance, age and knowledge of historical uses. Sampling for mercury-containing building materials and dismantling of suspect mercury-containing equipment was not performed. Where possible, attempts were made to verify the presence/absence of mercury by gathering additional information such as equipment model number, serial number, etc.

2.1.4 Silica

The presence of crystalline silica in building materials was determined through visual inspection of building materials only, based on knowledge of the historic use of silica-containing materials in certain building materials. Sampling to verify the presence/absence of silica in building materials was not performed.

2.1.5 Other Designated Substances

Other designated substances (i.e. acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride) are typically not expected to be encountered in building materials as significant constituents or in a form that would represent an exposure concern. These substances were not included in our assessment unless specific information regarding their use (e.g. in a manufacturing process) was provided to us. Please refer to Appendix E for information regarding where these designated substances are typically found or used. No sampling for these designated substances was performed.

2.2 Other Hazardous Materials

2.2.1 Chemical Hazards

Urea Formaldehyde Foam Insulation (UFFI)

A visual inspection to evaluate the possible presence of Urea Formaldehyde Foam Insulation (UFFI) was conducted within the area(s) assessed. Our visual inspection was limited to looking for evidence of possible UFFI installation (i.e. repaired nozzle holes in walls) and overspray at wall/ceiling joints, etc. No material sampling was conducted as part of our assessment.

2.2.2 Biological Hazards

Mould Contamination

A visual inspection to determine the possibility of indoor mould growth was conducted within the area assessed. Our assessment was limited to looking for evidence of mould growth and water damage (staining, material deterioration, efflorescence, etc.) on the surface of building materials, which may be an indicator of hidden mould growth. No moisture content readings of building materials were taken to determine their current condition. Additionally, destructive testing to confirm the presence/absence of hidden mould growth and material sampling to verify the presence/absence of mould on suspect surfaces was beyond the scope of this assessment.

2.2.3 Environmental Hazards

Polychlorinated Biphenyls (PCBs)

The presence of PCB-containing electrical equipment within the area(s) assessed was identified through visual inspection and knowledge of the timeline of historical use.

For stand-alone transformers and capacitors, information from the manufacturer nameplate (such as the date of manufacture, dielectric fluid trade name or “Type Number”, etc.) was gathered, where possible, to further evaluate if the equipment may contain PCBs. This information was then compared to the information provided in the Environment Canada document entitled “*Handbook on PCB’s in Electrical Equipment*” (Third Edition, April 1988) to aid in identification. Transformers and capacitors confirmed to be manufactured after 1979 were assumed to not contain PCBs. If appropriate information could not be obtained it was assumed that the transformer or capacitor contained PCBs.

No sampling of materials or fluids within equipment was conducted to verify the presence/absence of PCBs. Inspection and testing of other materials for PCB content, including (but not limited to) caulking, asphalt, oil-based paint, plastics, switches, oil residue, electric cables and hydraulic fluids was beyond the scope of our assessment.

Ozone Depleting and Global Warming Substances

The presence of fixed equipment likely to contain ozone-depleting substances (ODS) and/or global-warming substances (GWS) was identified through visual inspection and knowledge of the timeline of historical use. This included equipment such as chillers, air-conditioners and fixed dry-chemical fire extinguishers, where chemicals such as hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) or halons may be present. Where possible, information regarding the type and quantity of refrigerant present was obtained from the manufacturer nameplate.

Our visual assessment was limited to fixed equipment within the area(s) assessed and did not include portable equipment such as stand-alone refrigerators, freezers, water coolers, air-conditioners and fire extinguishers, etc.

3.0 RESULTS

Results of our visual assessment and bulk sample analytical findings are summarized in the sections below. Photographs of conditions observed are referenced in the appropriate section where applicable (as **P#**) and are included in Appendix D.

3.1 Designated Substances

3.1.1 Asbestos

Results of bulk sample analysis for the determination of asbestos content are summarized in Table 1. Materials have been classified as “ACM” or “Non-ACM” based on analytical results. Please refer to the Limitations section of this report (Section 5.0) for additional details. The Laboratory Certificate of Analysis is included in Appendix C.

TABLE 1
Bulk Sample Analytical Results for Determination of Asbestos Content
St. Andrews Senior Public School - 65 Victoria Avenue, Cambridge, Ontario
Sample Collection Date: January 7, 2025

Sample No.	Material Description	Sample Location	Asbestos Content	Material Classification
S01A	12"x12" Vinyl Floor Tile- White with Grey Fleck 2 Phases: a) White, Vinyl Floor Tile b) Black, Mastic	Hallway 805A	a) None Detected b) None Detected	Non-ACM
S01B				
S01C				
S02A	Silver Acoustic Sink Coat	Room 108	0.5% Chrysotile	ACM
S02B			Not Analyzed	
S02C			Not Analyzed	
S03A	Drywall Joint Compound	Room 108	None Detected	Non-ACM
S03B				
S03C				
S04A	Ceiling Texture Finish	Washroom 128	None Detected	Non-ACM
S04B				
S04C				
S05	Gold Acoustic Sink Coat	Room 305	1% Chrysotile	ACM

¹ As per O. Reg. 278/05, ACM contains ≥0.5% asbestos by dry weight.

² Not Analyzed = Not analyzed due to positive asbestos result in previous sample.

Materials assessed for asbestos content are summarized in Table 2 based on the type/use of the material. The condition and friability of materials confirmed or suspected to be asbestos-containing (based on our visual assessment and results of bulk sample analysis) is provided. Condition (Cond.) ratings are provided as Good (G), Fair (F) or Poor (P) based on our Assessment Criteria provided in Appendix A. Estimates of quantity have only been provided for confirmed or suspected asbestos-containing materials that were deemed to have a potential to be disturbed as part of the upcoming renovation project. Any quantities provided should be considered rough estimates only and only apply to the limited project-specific assessment areas.

TABLE 2
Results of Assessment for Asbestos-Containing Materials
St. Andrews Senior Public School - 65 Victoria Avenue, Cambridge, Ontario
Date of Assessment: January 7, 2025

Sprayed and Loose Fill Insulating Materials	Location/Description	Cond.	Est. Quantity	Friability
Sprayed Fireproofing	None identified in project-specific work areas.	N/A	N/A	N/A
Sprayed Insulation	None identified in project-specific work areas.	N/A	N/A	N/A
Loose Fill / Vermiculite Insulation	None identified in project-specific work areas.	N/A	N/A	N/A
Thermal System Insulation	Location/Description	Cond.	Est. Quantity	Friability
Mechanical Pipe Insulation – Straights	Mechanical pipe straights within the areas assessed were observed to be uninsulated or insulated with non-asbestos fibreglass. No asbestos-containing pipe straight insulation was identified within project-specific work areas.	N/A	N/A	N/A
Mechanical Pipe Insulation – Fittings (elbows, valves, tees, hangers, etc.)	Mechanical pipe fittings within the areas assessed were observed to be uninsulated or insulated with non-asbestos fibreglass. No asbestos-containing pipe fitting insulation was identified within project-specific work areas.	N/A	N/A	N/A
HVAC Duct Insulation	Ducts within the areas assessed were observed to be uninsulated.	N/A	N/A	N/A
Breeching / Exhaust Insulation	None identified in project-specific work areas.	N/A	N/A	N/A
Tank Insulation	None identified in project-specific work areas.	N/A	N/A	N/A
Boiler Insulation	None identified in project-specific work areas.	N/A	N/A	N/A

Architectural Finishes & Finishing Materials	Location/Description	Cond.	Est. Quantity	Friability
Sprayed Texture / Stucco Finishes	A stipple texture finish was identified on the ceiling of washroom 128 on the ground floor. This material was sampled and determined to be non-asbestos (refer to sample S04 in Table 1).	N/A	N/A	N/A
Plaster Finishes	Plaster finishes were identified throughout the assessed areas. This material was sampled during a previous environmental survey and has been determined to not contain asbestos (refer to the report referenced in Section 1.3).	N/A	N/A	N/A
Drywall Joint Compound	Drywall finishes were identified within room 108 and corridor 808. The associated joint compound was sampled and determined to be non-asbestos (refer to sample S03 in Table 1).	N/A	N/A	N/A
Ceiling Tiles	Location/Description	Cond.	Est. Quantity	Friability
Lay-in Acoustic Ceiling Tiles	2'x4' Short fissure and random pinhole patterned ceiling tiles were identified throughout the areas assessed. The tiles contained manufacturer's stamps indicating they were manufactured in 2003 when asbestos was no longer in use for this material.	N/A	N/A	N/A
Fixed-in-Place Ceiling Tiles	None identified in areas assessed.	N/A	N/A	N/A
Flooring	Location/Description	Cond.	Est. Quantity	Friability
Vinyl Floor Tiles	12"x12" white with grey fleck vinyl floor tiles were identified in hallway 805A and stage 123. The tiles and associated mastic were sampled and determined to be non-asbestos-containing (refer to sample S01 in Table 1).	N/A	N/A	N/A
	12"x12" brown dense fleck vinyl floor tiles were identified throughout the areas assessed. The tiles were assessed during a previous environmental survey and determined to not contain asbestos (refer to the report referenced in Section 1.3).	N/A	N/A	N/A
	12"x12" tan with white and brown streaks vinyl floor tiles were identified in rooms 309 and 310. The tiles were assessed during a previous environmental survey and determined to not contain asbestos (refer to the report referenced in Section 1.3).	N/A	N/A	N/A
	12"x12" orange dense fleck vinyl floor tiles were identified in room 305. The tiles were assessed during a previous environmental survey and determined to not contain asbestos (refer to the report referenced in Section 1.3).	N/A	N/A	N/A
	12"x12" grey dense fleck vinyl floor tiles were identified in room 108. The tiles were assessed during a previous environmental survey and determined to not contain asbestos (refer to the report referenced in Section 1.3).	N/A	N/A	N/A

Vinyl Sheet Flooring	Beige pebble patterned vinyl sheet flooring was identified in corridors 902 and 807 (P1). This material was sampled during a previous environmental survey and was determined to be asbestos-containing (refer to the report referenced in Section 1.3).	Good	~20m²	Non-Friable
	Orange vinyl sheet flooring was identified in corridor 813. This material was visually assessed and determined to be newly installed and heat sealed with no paper backing; it is therefore not suspected of containing asbestos.	N/A	N/A	N/A
Asbestos Cement Products	Location/Description	Cond.	Est. Quantity	Friability
Piping	None identified in project-specific work areas.	N/A	N/A	N/A
Roofing, Siding, Wallboard	None identified in project-specific work areas.	N/A	N/A	N/A
Other Cement Products	None identified in project-specific work areas.	N/A	N/A	N/A
Misc. Materials	Location/Description	Cond.	Est. Quantity	Friability
Acoustic Sink Coat	Silver acoustic sink coat was identified on the underside of one (1) sink in room 108 (P2). This material was sampled and determined to contain 0.5% Chrysotile asbestos (refer to sample S02 in Table 1).	Good	1 Sink	Non-Friable
	Gold acoustic sink coat was identified on the underside of one (1) sink in room 305 (P3). This material was sampled and determined to contain 1% Chrysotile asbestos (refer to sample S05 in Table 1)	Good	1 Sink	Non-Friable
Other Materials	Asbestos may be a component of other materials within the areas assessed which were not sampled due to inaccessibility. Any additional materials uncovered that are suspected of containing asbestos must be sampled prior to proceeding with any work.	N/D	N/D	N/D

Notes: N/A=Not Applicable; N/D=Not Determined

3.1.2 Lead

Laboratory analytical results for paints and surface coatings tested to determine lead content are summarized below in Table 3. The Laboratory Certificate of Analysis is included in Appendix C.

TABLE 3
Results of Paint Condition and Lead Content Assessment
65 Victoria Avenue, Cambridge, Ontario
Sample Collection Date: January 7, 2025

Sample No.	Location	Surface	Paint Colour	Condition	Lead Conc. (µg/g)	EACC Classification
LP01	Hallway 805A	Concrete Block Wall	White	Good	<5	'de-minimis' level of lead
LP02	Room 104	Concrete Block Wall	Cream	Good	22	'de-minimis' level of lead
LP03	Room 108	Drywall Wall	Grey	Good	<5	'de-minimis' level of lead
LP04	Room 310	Concrete Block Wall	Green	Good	1,920	'Lead-Containing'
LP05	Room 301	Concrete Block Wall	Beige	Good	7	'de-minimis' level of lead

Paint samples above 1000 µg/g but below 5000 µg/g are considered 'lead-containing' as per the October 2014 EACC Lead Guideline for Construction, Renovation, Maintenance or Repair. The interior green paint identified on interior concrete block walls was found to have lead concentrations between 1000 µg/g and 5000 µg/g and is considered to be 'lead-containing' (**P4**). Materials coated with lead-containing paints require special procedures when performing work that may disturb them or their coatings.

Paint samples below 1000 µg/g are considered 'de minimis' or 'virtually safe' level of lead as per the October 2014 EACC Lead Guideline for Construction, Renovation, Maintenance or Repair. The interior white, cream, grey, and beige paints identified on interior concrete block and drywall walls within the areas assessed were determined to contain 'de minimis' level of lead. Materials coated with 'de minimis' level of lead paints do not require special procedures when performing work that may disturb them or their coatings.

Additional minor lead-containing materials suspected present within the investigated area include the following:

- Lead solder used in pipe fittings or electrical equipment;
- Lead acid batteries in emergency lighting; and,
- Ceramic tile glazing.

3.1.3 Mercury

Mercury is deemed present in vapour form within fluorescent light tubes located throughout the areas assessed. No other equipment suspected of containing mercury was identified within the assessed areas.

3.1.4 Silica

A number of building materials were identified within the surveyed areas that are suspected to contain crystalline silica. This includes the following materials:

- Drywall and associated joint compounds;
- Plaster finishes;
- Texture finishes;
- Lay-in acoustic ceiling tiles;
- Caulking;
- Mastics;
- Brick and associated mortar; and,
- All concrete finishes and materials.

3.1.5 Other Designated Substances

Acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride were not included in our assessment as these substances are not expected to be a significant component of building materials or present in a form that would represent an exposure concern. Additionally, no specific information regarding their use was provided to us.

3.2 Other Hazardous Materials

3.2.1 Chemical Hazards

No visible evidence of UFFI installation (i.e. injection openings) or overspray of foam insulation at wall/ceiling joints was identified. In addition, UFFI insulation within interior wall cavities is not suspected. No other hazardous materials were identified nor are they suspected present.

3.2.2 Biological Hazards

Mould Contamination

No areas of mould growth were identified within the surveyed area(s).

3.2.3 Environmental Hazards

Polychlorinated Biphenyls (PCBs)

Fluorescent light fixtures were identified throughout the areas assessed. Lamp types that are ballast dependent were noted to be retrofitted with newer T8 lamps. Therefore, ballasts associated with all fluorescent light fixtures are not suspected of containing PCBs.

Ozone Depleting and Global Warming Substances

No Ozone Depleting / Global Warming Substances were identified within the assessed areas at the time of the assessment.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Designated Substances

4.1.1 Asbestos

Results of our assessment indicated that the following asbestos-containing materials are present within project-specific assessment areas that may be disturbed as part of the planned renovation project:

Non-Friable Asbestos-Containing Materials

- Beige pebble patterned vinyl sheet flooring in ground floor corridors 902 and 807;
- Silver acoustic coating on the underside of the sink within room 108; and,
- Gold acoustic coating on the underside of the sink within room 305.

No other asbestos-containing materials were identified or are suspected present within the project-specific assessment areas. This assessment was limited to sampling of materials that have the potential to be impacted by planned renovation work, as reported by the WRDSB. Assessment of other areas or materials within the building was not conducted. Asbestos-containing materials and other designated substances are present in other areas of the building, which are not identified in this report. If the scope of work expands beyond the limit of our assessment then stop work immediately and assess, as needed.

Vinyl sheet flooring finishes are a non-friable asbestos-containing material; however, due to the nature of the material, it is difficult to adequately wet prior to removal. Furthermore, for vinyl sheet flooring that is applied with adhesive, it is impossible to remove the material primarily intact. Therefore, removal of vinyl sheet floor shall be performed following Type 2 procedures if using non-powered hand tools, or powered tools equipped with HEPA-filtered dust collection systems, or Type 3 procedures if using powered tools without HEPA-filtered dust collection systems.

Non-friable asbestos-containing materials in GOOD condition such as acoustic sink coatings, can be managed in place until activities which could result in disturbance of this material. In the event the non-friable asbestos-containing materials are removed, Type 1 operations apply (provided that the material is wetted down and removed using non-powered hand held tools) as outlined in Ontario Regulation 278/05, *Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations* – made under the Ontario Occupational Health and Safety Act.

The removal or disturbance of ACM must follow the measures and procedures indicated in Ontario Regulation 278/05. This work should be conducted by workers who have received proper training by a “competent person” in the hazards of asbestos exposure, personal hygiene and work practices, and the use and care of respirators and protective clothing. Any worker/supervisor who works in a Type 3 operation must successfully complete the Asbestos Abatement Worker or Supervisor Training Program approved by the Ministry of Training, Colleges and Universities.

It is recommended that work involving the removal or disturbance of ACM be subject to inspection and testing to document conformance with Ontario Regulation 278/05 requirements. The degree of inspection and testing is dependent on site-specific conditions such as the type, duration, size and location of the work.

4.1.2 Lead

Interior green paint on concrete block walls within the project-specific assessment areas was determined to be ‘lead-containing’ in accordance with the October 2014 EACC publication Lead Guideline for Construction, Renovation, Maintenance or Repair. Lead may also be present as a component in solder in pipe fittings and electrical equipment, in lead-acid batteries of emergency light fixtures, and in ceramic tile glazing. Removal or disturbance of these materials, if applicable, should be performed using non-powered hand tools and no hot work should be performed on pipes containing solder.

Materials coated with lead-containing paints require special procedures when performing work that may disturb them or their coatings. Any disturbance of lead materials and/or lead-containing paints should be conducted in accordance with the procedures outlined in the EACC “Lead Guideline” (October 2014) and the MLITSD “Lead on Construction Projects” guideline (April 2011). The extent of procedures required depends on the type of work to be conducted.

If practicable, all bulk lead waste materials should be separated from other wastes and sent to a recycling facility. If not practicable, lead-containing waste should be handled and disposed of according to R.R.O. 1990 Regulation 347 (Reg. 347), *General – Waste Management*, made under the Environmental Protection Act. Under this regulation (and depending on the quantity of waste generated) the waste may be subject to analysis following the Toxicity Characteristic Leaching Procedure (TCLP) to determine if it is a “leachate toxic waste” based on the leachate quality criteria provided in Schedule 4 of the regulation. Such wastes must meet specific treatment requirements (Schedule 5) or undergo alternative treatment for hazardous debris (Schedule 8) prior to land disposal.

4.1.3 Mercury

Fluorescent lamps that require removal should be handled with care and kept intact to avoid potential exposure to mercury vapour present within the lamps. Under R.R.O. 1990 Regulation 347, waste mercury produced in amounts less than 5 kilograms (kg) in any month or otherwise accumulated in an amount less than 5 kg are exempt from hazardous waste registration, treatment and disposal requirements and can be disposed of in landfill as regular waste. Larger quantities of waste mercury must be treated and disposed of in accordance with the requirements of Reg. 347. Although it is anticipated that less than 5 kg of waste lamps will be produced as part of the planned demolition-level project, to prevent the release of mercury into the environment it is recommended that all waste lamps are sent to a lamp recycling facility and are not disposed of in landfill.

Although no mercury was visibly identified in equipment, dismantling of equipment (if present) was not conducted to verify the presence/absence of mercury. It is cautioned that thermometers, barometers, and other measuring devices (pressure gauges/sensors, vacuum gauges, manometers, etc.), thermostats, and a variety of other electrical switches (temperature sensitive, tilt switches, float switches, etc.) may contain mercury that may not be visible without dismantling the equipment. Such devices should be assumed to contain mercury until proven otherwise and similar precautions to those outlined above should be taken if any of those items are to be disturbed or taken out of service in the future.

4.1.4 Silica

Suspect silica-containing materials were identified throughout the assessed areas. In their current state, building materials containing silica do not represent a risk to building occupants or construction workers. Risks associated with exposure to silica arise during demolition activities that cause silica dust to be created (particularly grinding, drilling or cutting operations and during major demolition), resulting in a crystalline silica inhalation hazard.

If any materials suspected to contain silica are to be removed or otherwise disturbed as a result of renovation or demolition activities it is recommended that procedures be put in place to control the generation of dust (such as routine water misting) and thus reduce the potential for worker exposure. Workers that have the potential to be exposed to airborne silica should also wear appropriate protective clothing and respiratory protection.

Any work involving the disturbance of silica-containing materials should follow the procedures outlined in the MLITSD *"Silica on Construction Projects"* guideline (April 2011). The appropriate engineering controls, work practices, hygiene practices, personal protective measures and training necessary to conduct the work in a safe manner are provided in this guideline. The general measures and procedures (or Type of operation) necessary depends on the type of work to be conducted.

4.1.5 Other Designated Substances

No other designated substances are expected to be a component of building materials within the surveyed area in a form that would represent an exposure concern. Therefore, no protective measures or procedures specific to acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride are considered necessary.

4.2 Other Hazardous Materials

4.2.1 Chemical Hazards

As no UFFI was identified or is suspected to be present within the surveyed area no further action is required. However, although intrusive testing was conducted, there is a remote possibility that UFFI could be hidden within locations such as exterior wall cavities that were not investigated. If suspect foam insulation is identified during demolition activities work should be stopped and the area should be re-assessed to evaluate conditions and determine appropriate control measures and worker protection, if necessary.

4.2.2 Biological Hazards

Mould Contamination

No mould contamination was visually identified in the surveyed area(s) and therefore no further action is required at this time.

4.2.3 Environmental Hazards

Polychlorinated Biphenyls (PCBs)

None identified in the area(s) assessed, no action required.

Ozone Depleting and Global Warming Substances

None identified in the area(s) assessed, no action required.

5.0 LIMITATIONS

The information and recommendations detailed in this report were carried out by trained professional and technical staff in accordance with generally accepted environmental and industrial hygiene work practices and procedures. Recommendations provided in this report have been generated in accordance with accepted industry guidelines and practices. These guidelines and practices are considered acceptable as of the date of this report.

In preparation of this report, Safetech Environmental Limited (Safetech) relied on information supplied by others, including without limitation, information pertaining to the history and operation of the site, and testing services provided by independent laboratories. Except as expressly set out in this report, Safetech has not made any independent verification of information provided by independent entities.

The collection of samples at the location noted was consistent with the scope of work agreed-upon with the person or entity to whom this report is addressed and the information obtained concerning prior site investigations. As conditions between samples may vary, the potential remains for the presence of unknown additional contaminants for which there were no known indicators.

The analytical method used for determination of asbestos content meets the requirements of O.Reg. 278/05. However, small asbestos fibres may be missed by PLM due to resolution limitations of the optical microscope. Interfering binder/matrix and/or low asbestos content may also hinder positive identification by PLM. These conditions are common for vermiculite attic insulation (VAI) and non-friable organically bound (NOB) materials such as vinyl floor tiles, roofing materials, mastics and caulking and can lead to “false negative” results. If PLM analytical results for these types of materials indicate no asbestos detected they have been reported as “Presumed Non-ACM”. Due to limitations of the analytical method we cannot confirm that low quantities of asbestos are not present in these samples using solely PLM analysis. Additional analytical procedures should be considered for such materials to rule out false negative results.

Conclusions are based on site conditions at the time of inspection and can only be extrapolated to an undefined limited area around inspected locations. The extent of the limited area depends on building construction and conditions. Building materials that are not detailed within this survey due to inaccessibility during the time of survey and/or are uncovered during demolition activities should be properly assessed by a qualified person prior to their disturbance. Safetech cannot warrant against undiscovered environmental liabilities. If any information becomes available that differs from the findings in this report, we request that we be notified immediately to reassess the conclusions provided herein.

No other person or entity is entitled to use or rely upon this report without the express written consent of Safetech Environmental Limited and the person or entity to who it is addressed. Any use that a third party makes of this report, or any reliance based on conclusions and recommendations made, are the responsibility of such third parties. Safetech accepts no responsibility for damages suffered by third parties as a result of actions based on this report.

Appendix A

Condition Assessment Criteria for Asbestos-Containing Materials

The condition of asbestos-containing materials identified within the surveyed area(s) was assessed as Good (G), Fair (F) or Poor (P). The assessment criteria used to determine condition is dependent on material characteristics, such as friability. The following Table summarizes the criteria used by Safetech to evaluate the condition of ACM.

Condition Assessment Criteria for Asbestos-Containing Materials

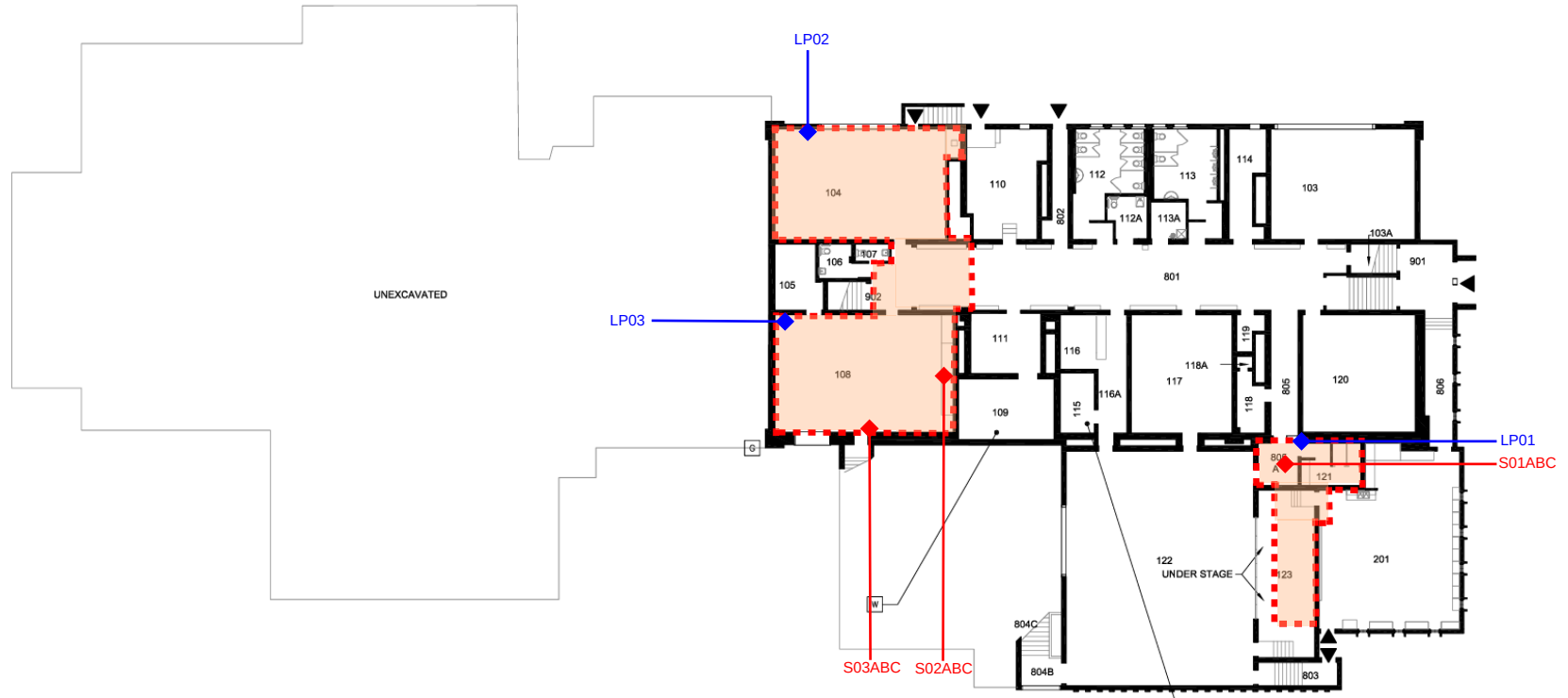
Sprayed Fireproofing, Sprayed Insulation and Sprayed Texture Finishes	
Good	• Surface shows no significant signs of damage, deterioration, or delamination (i.e. <1%). • Unencapsulated or unpainted fireproofing or texture finishes, where no delamination or damage is observed. • Encapsulated fireproofing or texture finishes where encapsulation applied after damage or fallout.
Fair	• Not utilized as part of condition assessment for these materials.
Poor	• Greater than 1% damage, delamination, or deterioration to surface.
In areas where damage exists in isolated locations, both Good and Poor may be applicable.	
Mechanical Insulation (boilers, breeching, ductwork, piping, tanks, equipment, etc.)	
Good	• Insulation completely covered in jacketing and exhibits no evidence of damage or deterioration. • Jacketing may have minor damage (i.e. scuffs or stains), but is not penetrated.
Fair	• Minor penetrating damage to jacketed insulation (cuts, tears, nicks, deterioration or delamination). • Undamaged insulation that had never been jacketed. • Insulation is exposed but not showing surface disintegration. • Extent of missing insulation ranges from minor to none. • Damage that can be repaired.
Poor	• Original insulation jacket is missing, damaged, deteriorated, or delaminated. • Insulation is exposed and significant areas have been dislodged. • Damage that cannot be easily repaired.
Non-Friable and Potentially Friable Materials (includes materials such as plaster finishes, drywall compound, ceiling tiles, asbestos cement products, vinyl asbestos tile and asbestos paper backed vinyl sheet flooring, etc., which have the potential to become friable when handled)	
Good	• No significant damage. • Material may be cracked or broken but is stable and not likely to become friable upon casual contact. • No friable debris present
Fair	• Not utilized as part of condition assessment for these materials.
Poor	• Material is severely damaged. • Debris is present or binder has disintegrated to the point where the material has become friable.
Asbestos-Containing Debris (noted separately from the presumed source material)	
Poor	• Debris is always considered to be in Poor condition.

Appendix B

Figures AS01, AS02 and AS03

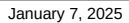
1. Refer to the report titled "Project-Specific Designated Substance & Hazardous Materials Assessment St. Andrews Senior Public School 65 Victoria Avenue, Cambridge, Ontario" for complete details.
2. Figured to be referenced with the report
3. Figure is not to scale
4. Floor plans provided by the Waterloo Region District School Board.
5. Figure is colour dependent; photocopies may alter interpretations of the figure.
6. Sample locations are approximate.
7. The project-specific assessment area was defined by the Waterloo Region District School Board.
8. This assessment was limited to sampling of materials that have the potential to be impacted by planned renovation work, as reported by the WRDSB.
9. Asbestos-containing materials and other designated substances are present in other areas of the building which are not identified in these figures of the report. If the scope of work expands beyond the limit of our assessment area then stop work immediately and assess as needed.

1. Beige pebble patterned vinyl sheet flooring in ground floor corridors 902 and 807;
2. Silver acoustic coating on the underside of the sink within room 108; and,
3. Gold acoustic coating on the underside of the sink within room 305.



SAMPLE LOCATION AND SURVEY LEGEND

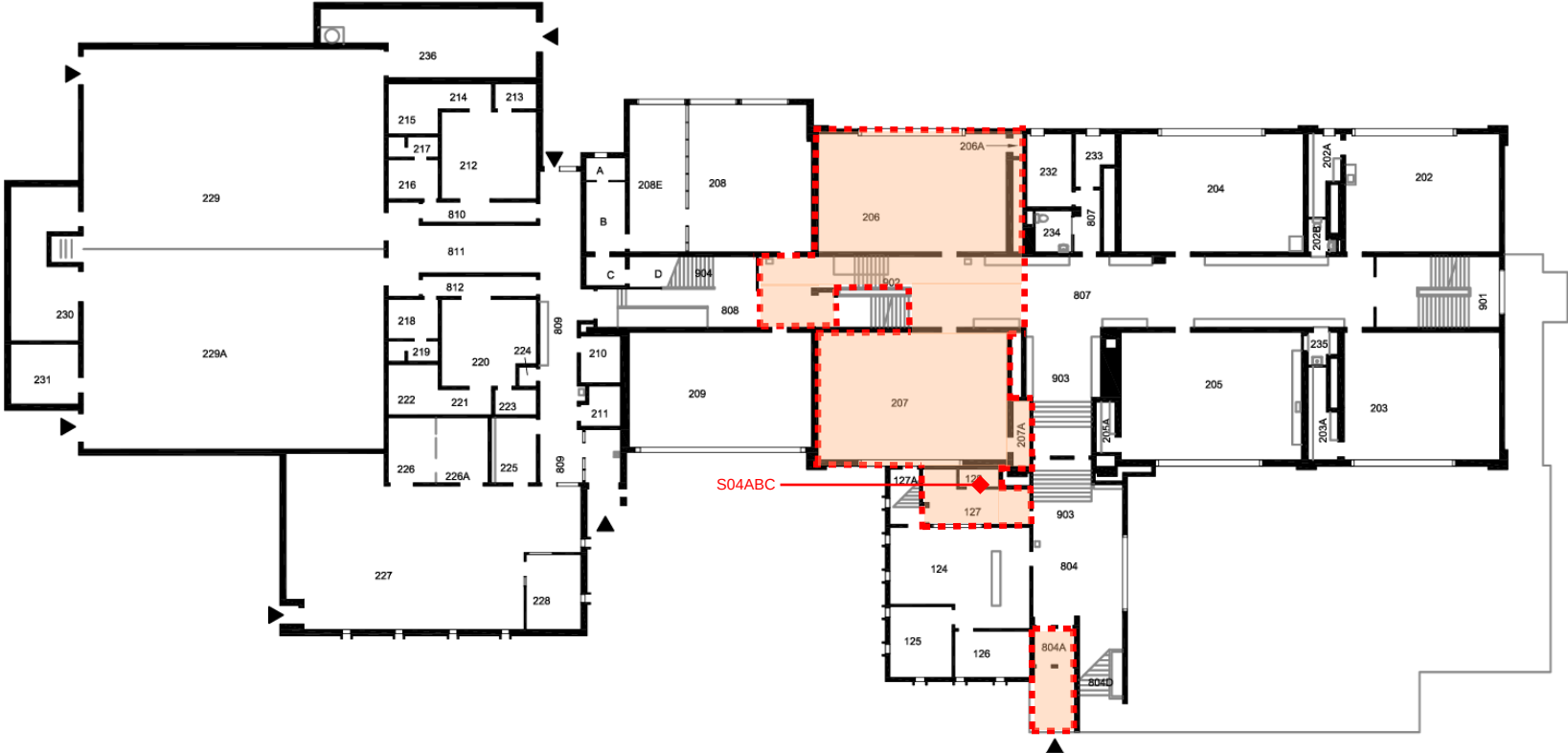
-  Asbestos Sample Location (approximate)
 Lead Sample Location (approximate)
 Extent of Assessment Area

PROJECT: Project-Specific Designated Substance & Hazardous Materials Assessment St. Andrews Senior Public School 65 Victoria Avenue, Cambridge, Ontario		DRAWING NAME: Extent of Assessment and Designated Substance & Hazardous Materials Sample Locations for the St. Andrews Senior Public School Renovation Project		Prepared for:	Prepared by:
Safetech Project Number:	2-3250001	Survey Date:	January 7, 2025	 Waterloo Region District School Board	 Safetech Environmental Ltd. work play live safe.
		Drawing By:	AN		
		Drawing #:	AS-01		
Building Address:	65 Victoria Avenue, Cambridge, Ontario	Approved By:	JG	Waterloo Region District School Board 51 Ardelt Avenue, Kitchener, Ontario, N2C 2R5	Safetech Environmental Limited 100 Hanson Avenue, Unit 2, Kitchener, Ontario N2C 2E2

- NOTES:**
- 1. Refer to the report titled "Project-Specific Designated Substance & Hazardous Materials Assessment St. Andrews Senior Public School 65 Victoria Avenue, Cambridge, Ontario" for complete details.
 - 2. Figured to be referenced with the report
 - 3. Figure is not to scale
 - 4. Floor plans provided by the Waterloo Region District School Board.
 - 5. Figure is colour dependent; photocopies may alter interpretations of the figure.
 - 6. Sample locations are approximate.
 - 7. The project-specific assessment area was defined by the Waterloo Region District School Board.
 - 8. This assessment was limited to sampling of materials that have the potential to be impacted by planned renovation work, as reported by the WRDSB.
 - 9. Asbestos-containing materials and other designated substances are present in other areas of the building which are not identified in these figures of the report. If the scope of work expands beyond the limit of our assessment area then stop work immediately and assess as needed.

The following asbestos-containing materials are present within the project-specific work areas:

- 1. Beige pebble patterned vinyl sheet flooring in ground floor corridors 902 and 807;
- 2. Silver acoustic coating on the underside of the sink within room 108; and,
- 3. Gold acoustic coating on the underside of the sink within room 305.



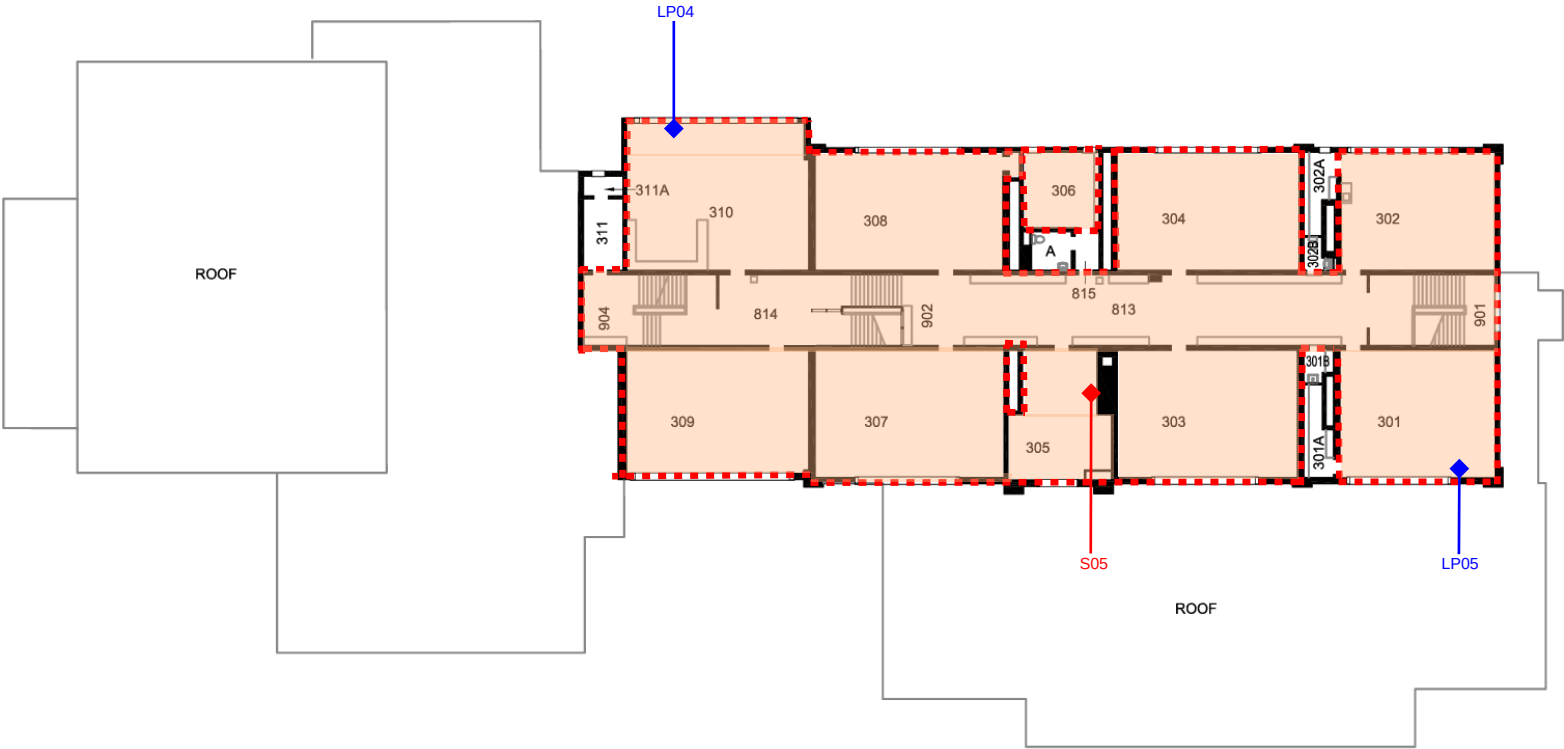
First Floor

SAMPLE LOCATION AND SURVEY LEGEND		PROJECT:		DRAWING NAME:		Prepared for:	Prepared by:
Asbestos Sample Location (approximate) Lead Sample Location (approximate) Extent of Assessment Area		Project-Specific Designated Substance & Hazardous Materials Assessment St. Andrews Senior Public School 65 Victoria Avenue, Cambridge, Ontario		Extent of Assessment and Designated Substance & Hazardous Materials Sample Locations for the St. Andrews Senior Public School Renovation Project			
Safetech Project Number:		2-3250001		Survey Date:	January 7, 2025	Waterloo Region District School Board 51 Ardelt Avenue, Kitchener, Ontario, N2C 2R5	Safetech Environmental Limited 100 Hanson Avenue, Unit 2, Kitchener, Ontario N2C 2E2
Building Address:		65 Victoria Avenue, Cambridge, Ontario		Drawing By:	AN		
				Drawing #:	AS-02		
				Approved By:	JG		

- NOTES:**
- 1. Refer to the report titled "Project-Specific Designated Substance & Hazardous Materials Assessment St. Andrews Senior Public School 65 Victoria Avenue, Cambridge, Ontario" for complete details.
 - 2. Figured to be referenced with the report
 - 3. Figure is not to scale
 - 4. Floor plans provided by the Waterloo Region District School Board.
 - 5. Figure is colour dependent; photocopies may alter interpretations of the figure.
 - 6. Sample locations are approximate.
 - 7. The project-specific assessment area was defined by the Waterloo Region District School Board.
 - 8. This assessment was limited to sampling of materials that have the potential to be impacted by planned renovation work, as reported by the WRDSB.
 - 9. Asbestos-containing materials and other designated substances are present in other areas of the building which are not identified in these figures of the report. If the scope of work expands beyond the limit of our assessment area then stop work immediately and assess as needed.

The following asbestos-containing materials are present within the project-specific work areas:

- 1. Beige pebble patterned vinyl sheet flooring in ground floor corridors 902 and 807;
- 2. Silver acoustic coating on the underside of the sink within room 108; and,
- 3. Gold acoustic coating on the underside of the sink within room 305.



Second Floor

SAMPLE LOCATION AND SURVEY LEGEND		PROJECT:		DRAWING NAME:		Prepared for:	Prepared by:
Asbestos Sample Location (approximate) Lead Sample Location (approximate) Extent of Assessment Area		Project-Specific Designated Substance & Hazardous Materials Assessment St. Andrews Senior Public School 65 Victoria Avenue, Cambridge, Ontario		Extent of Assessment and Designated Substance & Hazardous Materials Sample Locations for the St. Andrews Senior Public School Renovation Project			
Safetech Project Number:		2-3250001		Survey Date:	January 7, 2025	Waterloo Region District School Board 51 Ardelt Avenue, Kitchener, Ontario, N2C 2R5	Safetech Environmental Limited 100 Hanson Avenue, Unit 2, Kitchener, Ontario N2C 2E2
Building Address:		65 Victoria Avenue, Cambridge, Ontario		Drawing By:	AN		
				Drawing #:	AS-03		
				Approved By:	JG		

Appendix C

Laboratory Certificates of Analysis – Asbestos & Lead

Laboratory Analysis Report

To:

Alyssa Nagy
Safetech Environmental Ltd.
100 Hanson Avenue, Unit 2
Kitchener, Ontario
N2C 2E2

EMC LAB REPORT NUMBER: A113674
Job/Project Name: 65 Victoria Avenue
Analysis Method: Polarized Light Microscopy – EPA 600
Date Received: Jan 9/25 **Date Analyzed:** Jan 14/25
Analyst: Fabio Anunciacao
Reviewed By: Malgorzata Sybydlo

No. of Phases Analyzed: 14
Job No: 2-3250001
Number of Samples: 13
Date Reported: Jan 15/25

Client's Sample ID	Lab Sample No.	Description/Location	Sample Appearance	SAMPLE COMPONENTS (%)			
				Asbestos Fibres		Non-asbestos Fibres	Non-fibrous Material
S01a	A113674-1 ⁶	12"x12" vinyl floor tiles – white with grey fleck	2 Phases: a) White, vinyl floor tile b) Black, mastic	ND ND			100 100
S01b	A113674-2 ⁶	12"x12" vinyl floor tiles – white with grey fleck	2 Phases: a) White, vinyl floor tile b) Black, mastic	ND ND			100 100
S01c	A113674-3	12"x12" vinyl floor tiles – white with grey fleck	2 Phases: a) White, vinyl floor tile b) Black, mastic	ND ND			100 100
S02a	A113674-4	Silver acoustic sink coat	Black and silver, mastic	Chrysotile	0.5		99.5
S02b	A113674-5	Silver acoustic sink coat	NA	NA			
S02c	A113674-6	Silver acoustic sink coat	NA	NA			
S03a	A113674-7	Drywall joint compound	White, joint compound	ND			100
S03b	A113674-8	Drywall joint compound	Off white, joint compound	ND			100
S03c	A113674-9	Drywall joint compound	Off white, joint compound	ND			100
S04a	A113674-10	Texture finish on drywall ceiling	White, texture coat	ND			100
S04b	A113674-11	Texture finish on drywall ceiling	White, texture coat	ND			100
S04c	A113674-12	Texture finish on drywall ceiling	White, texture coat	ND			100

EMC LAB REPORT NUMBER: A113674
Client's Job/Project Name/No.: 2-3250001
Analyst: Fabio Anunciacao

Client's Sample ID	Lab Sample No.	Description/Location	Sample Appearance	SAMPLE COMPONENTS (%)			
				Asbestos Fibres		Non-asbestos Fibres	Non-fibrous Material
S05	A113674-13	Gold acoustic sink coat	Black and gold, mastic	Chrysotile	1		99

Note:

1. Bulk samples are analyzed using Polarized Light Microscopy (PLM) and dispersion staining techniques. The analytical procedures are in accordance with EPA 600/R-93/116 method.
2. The results are only related to the samples analyzed. **ND** = None Detected (no asbestos fibres were observed), **NA** = Not Analyzed (analysis stopped due to a previous positive result)
3. This report may not be reproduced, except in full without the written approval of EMC Scientific Inc. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.
4. The Ontario Regulatory Threshold for asbestos is 0.5%. The limit of quantification (LOQ) is 0.5%.
5. Vinyl floor tiles may contain very fine asbestos fibres which the PLM method cannot detect. TEM analysis may be necessary to confirm the absence of asbestos.
6. Phase b) is small in size.

C.O.C.: -

REPORT No: 25-000891 - Rev. 0

Report To:

EMC Scientific Inc.
5800 Ambler Dr. #100
Mississauga, ON L4W 4J4

CADUCEON Environmental Laboratories

2378 Holly Lane
Ottawa, ON K1V 7P1

Attention: Alister Haddad

DATE RECEIVED: 2025-Jan-10
DATE REPORTED: 2025-Jan-13
SAMPLE MATRIX: Paint Chips

CUSTOMER PROJECT: 65 Victoria Avenue, Cambridge
P.O. NUMBER: 2-3250001

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
ICP/OES (Solid)	5	OTTAWA	APRUDYVUS	2025-Jan-10	D-ICP-02	EPA 6010

R.L. = Reporting Limit

NC = Not Calculated

Test methods may be modified from specified reference method unless indicated by an *

Client I.D.	Sample I.D.	Date Collected	Parameter
			Lead
			Units
			R.L.
			µg/g
			5
			-
LP01 White on concrete wall	25-000891-1	2025-Jan-07	<5
LP02 Cream on concrete wall	25-000891-2	2025-Jan-07	22
LP03 Grey on drywall wall	25-000891-3	2025-Jan-07	<5
LP04 Green on concrete wall	25-000891-4	2025-Jan-07	1920
LP05 Beige on plaster wall	25-000891-5	2025-Jan-07	7



Michelle Dubien
Data Specialist

Appendix D

Site Photographs – January 7, 2025



P1 – Asbestos-Containing Beige Pebble Vinyl Sheet Flooring

Asbestos-containing beige pebble patterned vinyl sheet flooring was identified in ground floor corridors 902 and 807.



P2 – Asbestos-Containing Silver Acoustic Sink Coating

Asbestos-containing silver acoustic sink coating was identified on the underside of one (1) sink within room 108.



P3 – Asbestos-Containing Gold Acoustic Sink Coating

Asbestos-containing gold acoustic sink coating was identified on the underside of one (1) sink within room 305.



P4 – ‘Lead-Containing’ Interior Green Paint

Lead-containing green paint was identified on interior walls of room 310 (red arrow).

Appendix E

Background Information on Designated Substances and Other Hazardous Materials

DESIGNATED SUBSTANCES

The Occupational Health and Safety Act of Ontario (OHSA) allows for certain toxic substances to be especially designated. The OHSA defines a designated substance as “a biological, chemical, or physical agent or combination thereof prescribed as a designated substance to which the exposure of a worker is prohibited, regulated, restricted, limited, or controlled.” Ontario Regulation 490/09 - Designated Substances (O. Reg. 490/09), made under the Occupational Health and Safety Act outlines required steps to control exposure of workers to designated substances. Under O. Reg. 490/09 there are eleven (11) designated substances; acrylonitrile, arsenic, asbestos, benzene, coke oven emissions, ethylene oxide, isocyanates, lead, mercury, silica and vinyl chloride. This regulation applies to every employer and worker at a workplace where the designated substances are present, produced, processed, used, handled or stored and at which a worker is likely to be exposed to the designated substance.

Section 14 of O. Reg. 490/09 exempts an employer and the workers of an employer who engage in construction from the requirements of the regulation. However, designated substances are still required to be identified prior to the beginning of a demolition or renovation project to ensure that construction workers (and potentially building occupants) are adequately protected from the hazards posed by the presence of these materials if the planned work may cause them to be disturbed. Accordingly, under Section 30 of the OHSA building owners are required to perform an assessment to determine whether any designated substances are present at the project site before the beginning of the project. The owner is also required to prepare a list of designated substances that are present at the site and provide this list to prospective constructors before entering into a binding contract with the constructor. This way, contractors and construction workers are made aware of designated substances present within the work area so that appropriate measures can be taken during the work to limit exposure to these substances.

Designated Substances and Hazardous Materials Assessments are conducted to conform to the requirements of Section 30 of the OHSA. The assessments are performed to identify designated substances (and other hazardous materials) within the work area that may present a hazard to workers if disturbed. These substances are commonly a component of building materials or equipment found in buildings. Additional information regarding the eleven designated substances including their properties, uses and health effects are provided below.

Acrylonitrile

Acrylonitrile (ACN) is a clear, colourless or pale yellow liquid with a pungent onion- or garlic-like, irritating odour. It is highly flammable and as such is a severe fire and explosion hazard.

Acrylonitrile is used mainly as a monomer or comonomer in the production of acrylic fibres, plastics, resins and nitrile rubbers. Historically, a mixture of acrylonitrile and carbon tetrachloride was used as a pesticide; however, all pesticide uses have stopped. Based on its use as a chemical intermediate, exposure to acrylonitrile is primarily occupational, via inhalation during its manufacture and use. Therefore, this designated substance is not expected to be encountered in buildings where it is not either produced or used in a manufacturing process.

Acute (short-term) exposure of workers to acrylonitrile has been observed to cause mucous membrane irritation, headaches, dizziness, and nausea. More significant exposures may lead to symptoms such as limb weakness, labored and irregular breathing, impaired judgment, cyanosis, collapse, and convulsions. Exposure of the skin to high concentrations of acrylonitrile in the air may irritate the skin and cause it to turn red while direct skin contact with acrylonitrile may cause the skin to blister and peel. The International Agency for Research on Cancer (IARC) concluded that there is inadequate evidence in humans for the carcinogenicity of acrylonitrile, but has classified it as possibly carcinogenic to humans (Group 2B).

Arsenic

Arsenic is a naturally occurring mineral, widely distributed in the earth's crust. Elemental arsenic (sometimes referred to as metallic arsenic) is a silver-gray or white brittle metal. However, arsenic is usually found in the environment combined with other elements such as oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic has no odour and is almost tasteless.

Arsenic and its compounds have a variety of commercial uses. Inorganic arsenic compounds are mainly used as a wood preservative. Copper chromated arsenic (CCA) is used to make "pressure-treated" lumber. CCA-treated wood is no longer used for residential applications but may still be used in industrial applications. Arsenic is also used in metallurgy for hardening copper, lead and certain metal alloys, in pigment production, in the manufacture of certain types of glass, and in semiconductors and light-emitting diodes. Inorganic arsenic compounds are no longer used as pesticides in agriculture; however, organic arsenic compounds, namely cacodylic acid, disodium methylarsenate (DSMA), and monosodium methylarsenate (MSMA), are used, as yet, as pesticides – principally on cotton.

Today, workplace exposure to arsenic may still occur in some occupations that use arsenic, such as copper or lead smelting, wood treating, or pesticide application. Exposure to arsenic within buildings other than where it is used as part of the manufacturing process is unlikely and therefore arsenic is not expected to be encountered as part of a routine hazardous building materials assessment.

Human exposure to arsenic can cause both short and long term health effects. Short-term or acute effects can occur within hours or days of exposure. If you breathe high levels of inorganic arsenic, then you are likely to experience a sore throat and irritated lungs. Longer exposure at lower concentrations can lead to skin effects (such as darkened patches of skin and areas of thickened skin), and also to circulatory and peripheral nervous disorders. An important concern is the ability of inhaled inorganic arsenic to increase the risk of cancer. Long term exposure to arsenic has been linked to cancer of the bladder, lungs, skin, kidneys, nasal passages, liver and prostate. The IARC classifies arsenic and arsenic compounds as "carcinogenic to humans" (Group 1).

Asbestos

Asbestos is the name given to a number of naturally occurring fibrous minerals found in the environment. Ontario Regulation 490/09 (Designated Substances) defines asbestos as any one of the following fibrous silicates: actinolite; amosite; anthophyllite; chrysotile; crocidolite; and tremolite. Asbestos fibres have several desirable characteristics such as high textile strength, the ability to be spun and woven, and resistance to heat and most chemicals. These characteristics have resulted in the historical use of asbestos in a wide variety of building materials and other manufactured goods. Examples of products where asbestos has been used include roofing shingles, ceiling and floor tiles, insulation, sprayed fireproofing, gaskets, and friction products such as automotive brakes and clutches.

The peak years for asbestos use were in the 1960s and early 1970s. Therefore, asbestos is commonly found in building materials of this era. The use of asbestos in building materials and other products has decreased significantly since this time. Friable asbestos-containing materials (material that when dry can be crumbled, pulverized or powdered by hand pressure), such as sprayed fireproofing and sprayed insulation, ceased use circa 1973. Mechanical thermal system insulation ceased use circa 1981 while sprayed acoustic texture coat finishes ceased use circa 1982. Non-friable asbestos-containing materials were generally manufactured for a longer period of time (with the exception of plaster finishes which ceased use circa 1960's). Asbestos-containing drywall joint compound ceased use circa 1980. Vinyl floor tiles, vinyl sheet flooring and acoustic ceiling tile ceased use 1982. Other non-friable materials continued to be produced into the 1990's, including roofing materials (ceased use circa 1991) and floor adhesives (ceased use circa 1992). Today, asbestos is a controlled substance, and is banned for use in most products sold in Canada under the Hazardous Products Act (with the exception of certain roof shingles, clutch facings and brake linings).

Potentially harmful exposure to asbestos occurs through inhalation of air containing asbestos fibres. The greatest risk for workplace exposure to airborne asbestos is in occupations that produce and use asbestos, such as in mining and milling operations or in the manufacture of products containing asbestos. Exposure to airborne asbestos fibres may also occur to construction workers, trades people, maintenance workers and other building occupants in buildings constructed with asbestos-containing materials; especially during building renovations or repairs or if the materials are in poor condition or are otherwise disturbed.

Health risks associated with asbestos exposure are dependent on several factors such as the type and airborne concentration of asbestos, and period of exposure. In general, the greater the exposure to asbestos, the greater the chance of developing harmful health effects. Typically, chronic, daily exposure to elevated airborne concentrations of asbestos over a period of years is required for health effects to eventually manifest themselves. Health effects associated with exposure to asbestos can result in asbestosis (a scarring of the lungs which makes breathing difficult), mesothelioma (a rare cancer of the lining of the chest or abdominal cavity) and lung cancer. The link between exposure to asbestos and other types of cancers and health effects is less clear.

Benzene

Benzene is a clear, colourless liquid with a characteristic, sweet or aromatic hydrocarbon odour. It is a liquid at room temperature but evaporates into the air very quickly, making it a highly flammable vapour as well as an extremely flammable liquid.

Benzene is formed from both natural processes and human activities. Natural sources of benzene include volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke. It is produced from petroleum and coal sources and is used mainly in the manufacture of other chemicals which are used to make plastics, resins, and nylon and synthetic fibres. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides.

Exposure to pure benzene within buildings other than where it is produced or used as part of a manufacturing process is unlikely. Therefore benzene is not expected to be encountered as part of a routine hazardous building materials assessment.

Exposure to benzene primarily occurs through inhalation of airborne vapours. Short-term (acute) health effects associated with overexposure to benzene vapours can result in symptoms such as headache, nausea, dizziness, drowsiness and confusion, with unconsciousness or even death at very high levels. Long-term (chronic) exposure to Benzene may cause blood and bone marrow effects which can lead to anemia and leukemia (cancer of the blood-forming organs) as well as cause damage to the immune system, increasing the chance for infection. The IARC classifies benzene as "carcinogenic to humans" (Group 1).

Coke Oven Emissions

Coke Oven Emissions refers to the benzene soluble fraction of total particulate matter emitted during the destructive distillation or carbonization of coal for the production of coke (pure carbon). These emissions are a mixture of coal tar, coal tar pitch, volatiles (including benzene, toluene and xylene), creosote, polycyclic aromatic hydrocarbons (PAHs – including benzo(a)pyrene, benzanthracene, chrysene and phenanthrene), and metals (including cadmium, arsenic, beryllium and chromium). Condensed coke oven emissions are a brownish, thick liquid or semisolid with a naphthalene-like odour, while uncondensed coke oven emissions are vapours that escape when the ovens are changed and emptied and are a component of fugitive emissions.

The coke produced is used as a component in the manufacturing of iron and steel. Coke is also used to synthesize calcium carbide and to manufacture graphite and electrodes. Additional chemicals recovered from the coke oven emissions (such as benzene, toluene, naphthalene, sulfur, and ammonium sulfate) are used as raw materials for plastics, solvents, dyes, drugs, waterproofing, paints, pipe coating, roads, roofing, insulation, and as pesticides and sealants.

Coke oven emissions would only be present within facilities producing or using coke as part of the manufacturing process and thus occupational exposure is limited to those workers in the aluminum, steel, graphite, electrical, and construction industries. Therefore, coke oven emissions are not a contaminant of concern during a routine hazardous building materials assessment.

Chronic (long-term) exposure to coke oven emissions can result in chronic bronchitis (particularly those who smoke) and additional health effects such as conjunctivitis, severe dermatitis, and lesions of the respiratory system and digestive system. However, the greatest concern regarding chronic exposure to coke oven emissions is the increased risk of cancer. The IARC classifies coke production as "carcinogenic to humans" (Group 1). The site at which excess cancer rates have been identified most commonly among workers in coke production is the lung. Excess risk for kidney cancer has also been associated with work in coke plants. Additional studies have also reported excess risks for other types of cancers such as cancer of the large intestine and pancreas.

Ethylene Oxide

Ethylene oxide is colourless gas with a somewhat sweet odour. It is extremely flammable and also dangerously reactive. Ethylene oxide exists as a compressed gas that has been produced since the early 1900s. It is used primarily as a chemical intermediate in the production of ethylene glycol, glycol ethers, non-ionic surfactants and other industrial chemicals. Much smaller amounts are used as a non-explosive mixture with nitrogen or carbon dioxide for sterilizing medical instruments and supplies in hospitals and industrially for the fumigation of spices.

Most people are not likely to be exposed to ethylene oxide because it is not commonly found in the environment. Exposure to ethylene oxide is generally limited to those facilities where it is made or used. Therefore, ethylene oxide is not a contaminant of concern during a routine hazardous building materials assessment, although the presence of it should be determined in buildings such as hospitals if construction activities are to occur in or adjacent to areas where it is used or stored.

Exposure to ethylene oxide can result in irritation to the skin or eyes; however, the greatest risk for health effects is through inhalation. This can result in irritation to the nose, throat and respiratory tract, with damage to the central nervous system at higher concentrations. Exposure to high concentrations may cause headache, nausea, dizziness, drowsiness, and incoordination. Exposure to ethylene oxide is also a cancer hazard and possible reproductive hazard. In epidemiological studies of exposure to ethylene oxide, the most frequently reported association has been with lymphatic and haematopoietic cancer. The IARC has concluded that there is limited evidence for the carcinogenicity of ethylene oxide in humans and sufficient evidence for carcinogenicity in experimental animals, classifying ethylene oxide as “carcinogenic to humans” (Group 1).

Isocyanates

Isocyanates are a family of highly reactive, low molecular weight, manufactured chemicals containing one or more isocyanate groups (-NCO). An isocyanate that has two isocyanate groups is known as a diisocyanate, which are the most common type of isocyanates used for manufacturing other products. The most commonly used diisocyanates include methylene diphenyl diisocyanate (MDI), toluene diisocyanate (TDI), and hexamethylene diisocyanate (HDI).

When isocyanates are combined with other compounds that contain free hydroxyl functional groups (i.e. -OH) they react and begin to form polyurethane polymers. These polyurethanes find significant application in the manufacture of rigid and flexible foams. Flexible foam is primarily used for cushioning, while rigid foam is used mainly for insulation. Polyurethanes are also used in the production of adhesives, elastomers, and coatings and are increasingly used in the automobile industry, autobody repair, and building insulation materials.

This diversity of applications means that exposures to isocyanates can occur in a broad range of production facilities from small workshops to automated production lines. Jobs that may involve exposure to isocyanates include painting, foam-blowing, and the manufacture of many polyurethane products. Exposure to isocyanates within buildings where it is not produced or used as part of manufacturing is unlikely, as products such as rigid foam insulation that may be used in buildings has already undergone the curing process. Completely cured products are fully reacted and therefore are considered to be inert and non-toxic. However, some products such as spray foams, coatings, sealants and adhesives may be sold and used in an uncured form. An example would be an adhesive, which is sold to be initially applied in an uncured form and as it cures (hardens), bonds two pieces of wood together. Such products can provide potential exposure to building occupants and construction workers during the application and use of these products. However, for the purposes of a routine hazardous building materials assessment, products that may have contained isocyanate as part of the manufacturing process (e.g. rigid foam) or during the application/installation process (e.g. spray foam, adhesives and sealants) are assumed to be fully cured and would no longer contain free isocyanate.

Direct skin contact with isocyanates can cause marked skin irritation, resulting in reddening, swelling and blistering. However the greatest route of exposure to isocyanates is through inhalation of fine vapours or droplets. Airborne exposure to isocyanates can result in irritation to the mucous membranes of the eyes and respiratory tracts. This results in symptoms such as excessive tear secretion, dry throat, dry cough, chest pains and difficulty in breathing. Isocyanates are also a major cause of work-related asthma worldwide. Increased exposure to isocyanates can lead to sensitization. Once sensitized, individuals are subject to severe asthma attacks (which in some cases has been reported to result in death) if they are re-exposed.

Lead

Lead is a naturally occurring metal found in small amounts in the earth's crust. It is usually found in ore with zinc, silver and (most abundantly) copper, and is extracted together with these metals. Metallic lead is bluish-white in colour but soon tarnishes to a dull grey when exposed to air. When melted into liquid form it has a shiny chrome-silver appearance.

Lead is soft, dense, highly malleable and resistant to corrosion, with poor electrical conductivity as compared to most other metals. Such properties have resulted in lead being used in many applications, including products and materials commonly found in buildings. It is present as a component of lead-acid batteries, ammunition, PVC plastics, and older brass and chrome-plated brass faucets. As a building component, lead has been used in water distribution piping, as an alloy in solder, in electrical conduits, roofs and roofing details, and as an additive to paints, ceramic glazes and mortars as pigments

or for anti-corrosion properties. Lead has also used as sheeting inside buildings for shielding X-rays and for sound attenuation.

Exposure to lead can occur for workers in workplaces that produce the above materials but also to construction workers, building maintenance personnel and the general population due to the widespread historical use of lead in building materials and consumer products. Most exposure to lead occurs through ingestion or inhalation, with the health effects being the same. Overexposure to lead can result in damage to nervous connections and can cause blood and brain disorders, severe damage to the kidneys and ultimately death. Infants and young children are especially vulnerable to the health effects of lead, as overexposure has been proven to result in the permanent reduction in cognitive capacity. In pregnant women, high levels of exposure to lead may cause miscarriage. The IARC has concluded that lead and inorganic lead compounds are “possibly carcinogenic to humans” (Group 2B).

The known serious health effects associated with lead exposure has brought about widespread reduction in its use. The use of lead in building materials and consumer products has decreased substantially since the 1970s to where lead is no longer being used in building materials and consumer products or is present at significantly lower concentrations. For example, unleaded gasoline was introduced in Canada in 1975, after which leaded gasoline was phased out and banned in 1990. Lead-based solder has been banned since the 1980s and most solder used today is either lead-free or has very low lead concentrations. Up until the 1960s, lead was added to paints in significant quantities. Since that time, the concentration of lead in paint has decreased. The federal government began reducing the amount of lead allowed in interior paint in 1976 (to 0.5% by weight). By 1991, paint manufacturers in Canada and the U.S. voluntarily stopped adding lead to paint, reducing lead concentrations to background levels. In 2005 the *Surface Coating Materials Regulations* came into effect to limit the concentration of lead in paint (to 0.06% by weight) for both interior and exterior paints sold to consumers. This was since amended in 2011 to further reduce the allowable lead limit (to 0.009% by weight) and extended to include all consumer paints and coatings.

Mercury

Mercury is a naturally occurring element found in the earth's crust, with natural deposits generally found as a vermilion red ore called cinnabar. Mercury can exist as metallic mercury, organic mercury or inorganic mercury. Metallic or elemental mercury has unique properties as compared to other metals. It is the only pure metal that is a liquid at room temperature, having a silvery-white, shiny appearance. Mercury is the densest liquid known, which produces a colourless, odourless vapour at room temperature.

The unique properties of mercury have resulted in it being used in a wide variety of applications. Properties such as its coefficient of expansion and ability to conduct electricity has resulted in mercury being used in thermometers, barometers and other

measuring devices (blood pressure gauges, vacuum gauges, manometers, etc.), thermostats and a variety of other electrical switches (temperature sensitive, tilt switches, float switches, etc.). Mercury is also used in antifouling paints, dry cell or button batteries, and numerous lighting products, including fluorescent lamps and a variety of High Intensity Discharge (HID) lamps such as mercury vapour, metal halide and high pressure sodium lamps. HID lamps are used for street lights, floodlights and industrial lighting applications. Because of the wide variety of uses mercury can be found as a component of machinery, equipment and lighting within buildings; although many of its uses have been phased out over the years.

The health effects of mercury exposure depend on its chemical form (elemental, inorganic or organic), the route of exposure (inhalation, ingestion or skin contact), and the level of exposure. Vapours from liquid elemental mercury and methyl mercury are more easily absorbed than inorganic mercury salts and can, therefore, cause more harm. Exposure to mercury occurs mainly from breathing contaminated air or ingesting contaminated water and food. Mercury is a neurotoxin, which means it can adversely affect the central nervous system. Upon exposure, mercury tends to accumulate quickly in the brain where it tightly binds with the tissue and is released at a very slow rate. The nervous system effects of mercury toxicity are sometimes referred to as "Mad Hatter's Disease" since mercurous nitrate was used in making felt hats. High levels of exposure to mercury can also lead to harmful effects on the digestive and respiratory systems, and the kidneys. Many mercury compounds may also be teratogenic or capable of causing birth defects.

Mercury compounds can also be toxic at low levels in the environment. The characteristics of mercury that make it an environmental problem are its toxicity and persistence in the environment, and its ability to accumulate and bioconcentrate as methyl mercury in fish and fish-eating predators such as large fish or loons. Therefore, proper disposal of mercury-containing materials is essential. The improper disposal of mercury-containing products such as fluorescent light bulb tubes, high intensity discharge lamps, mercury vapour lamps, mercury thermometers and thermostats can lead to the release of mercury from municipal landfills. Used fluorescent and HID lamps may be classified as hazardous waste due to their mercury content and should be recycled if possible rather than being disposed of in landfill.

Silica

Silica (silicon dioxide) is the name of a group of minerals that contain silicon and oxygen in a chemical combination and have the general formula SiO_2 . It is one of the most common minerals in the earth's crust. Silica can be present as crystalline silica (free silica) or amorphous silica (combined silica), and exists in many forms. The three most common crystalline forms of silica encountered in the workplace environment are quartz, tridymite, and cristobalite. Quartz is by far the most common crystalline silica found in nature, being abundant in most rock types, notably granites, sandstones, quartzites and in sands and soils. Cristobalite and tridymite are found in volcanic rocks. Amorphous silica is found in

nature as biogenic silica and as silica glass of volcanic origin. One form of biogenic silica, diatomaceous earth, originates from the skeletons of diatoms deposited on sea floors. From a health perspective it is the crystalline silica forms that raise the biggest concerns.

Silica is present in numerous building materials and products, including concrete, brick, stone, terrazzo, refractory brick, etc. Low concentrations of silica are also possible in plaster, drywall, acoustical ceiling tiles, drywall joint compound, mortars and adhesives. Because of the wide usage of quartz-containing materials, workers may be exposed to crystalline silica in a large variety of industries and occupations. Occupational exposure to silica dust occurs in cement and brick manufacturing, asphalt pavement manufacturing, china and ceramic manufacturing, and the tool and die, steel and foundry industries. Exposure to silica also occurs during many different construction and maintenance activities. The most severe exposures to crystalline silica result from abrasive blasting activities using silica sand. Other activities that may produce crystalline silica dust include jack hammering, rock/well drilling, concrete mixing, concrete drilling, tuck pointing, and brick and concrete block cutting and sawing. Additionally, crystalline silica exposures occur in the maintenance, repair and replacement of refractory brick furnace linings.

Adverse health effects associated with silica exposure result from inhalation of the respirable fraction of crystalline silica, which can arise from many of the activities outlined above. The main health effects associated with silica exposure are lung cancer and silicosis. The IARC has concluded that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is “carcinogenic to Humans” (Group 1). Silicosis is caused by scarring of the lung tissue from breathing in silica dust. This scarring is permanent and causes a reduction in the lungs’ ability to take in oxygen, making it difficult to breathe and in severe cases can be disabling, or even fatal. Since silicosis affects lung function, it also makes one more susceptible to lung infections like tuberculosis.

Vinyl Chloride

Vinyl chloride is a manufactured substance that does not occur naturally. It is used as a chemical intermediate and not an end product. Vinyl chloride exists in liquid form if kept under high pressure or at low temperatures. At room temperature, it is a colourless gas. It burns easily and is not stable at high temperatures.

Most of the vinyl chloride produced is used to make a polymer called polyvinyl chloride (PVC). PVC is used to make a variety of plastic products including pipes, wire and cable coatings, vinyl flooring, vinyl wallpaper and window frames. It is also used to make furniture, upholstery and packaging materials. One of the concerns regarding PVC is that upon burning it will emit toxic fumes. Contaminants emitted when PVC is burned include hydrochloric acid, carbon monoxide, and carbon dioxide, along with lesser amounts of dioxin and furan.

Vinyl chloride is reported to be slightly irritating to the eyes and respiratory tract in humans. Central nervous system effects (including dizziness, drowsiness, fatigue, headache, visual and/or hearing disturbances, memory loss, and sleep disturbances) as well as peripheral nervous system symptoms (peripheral neuropathy, tingling, numbness, weakness, and pain in fingers) have been reported in workers exposed to vinyl chloride. Short-term (acute) exposure to extremely high levels of vinyl chloride has also reportedly caused loss of consciousness, lung and kidney irritation, and inhibition of blood clotting in humans. The most significant health effect associated with exposure to vinyl chloride is that it is a known human carcinogen that causes a rare cancer of the liver. It has been classified by the IARC as "carcinogenic to humans" (Group 1). Brain cancer, lung cancer, and some cancers of the blood also may be connected with breathing vinyl chloride over long periods.

OTHER HAZARDOUS MATERIALS

CHEMICAL HAZARDS

Urea Formaldehyde Foam Insulation

Urea-formaldehyde foam insulation (UFFI) was developed in as an improved means of insulating difficult-to-reach cavities. It was typically made at the construction site from a mixture of urea-formaldehyde resin, a foaming agent and compressed air. When the mixture is injected into the wall, urea and formaldehyde unite and "cure" into an insulating foam plastic. Its appearance is like ordinary shaving cream. Dry, it can be a white or tan colour, and fluffy like styrofoam. Over time UFFI shrinks significantly and may begin to degrade due to its crumbly texture.

UFFI was installed primarily in wall cavities during the 1970's as an energy conservation measure. The insulation was used most extensively from 1975 to 1978, during the period of the Canadian Home Insulation Program (CHIP), when financial incentives were offered by the government to upgrade home insulation levels. In addition to detached homes it can be found in common areas and walls of semi-detached homes, apartment buildings and condominiums. UFFI was also used to a lesser degree in some commercial and industrial buildings.

UFFI installation has been banned in Canada under the Hazardous Products Act (HPA) since December, 1980 due to concerns regarding the health effects of exposure to formaldehyde. Formaldehyde is a colourless, pungent-smelling gas. Health effects include eye, nose, and throat irritation; wheezing and coughing; fatigue; skin rash; nausea; headache; dizziness; and severe allergic reactions.

Sometimes, a slight excess of formaldehyde was often added to ensure complete "curing" with the urea to produce the urea-formaldehyde foam. The excess formaldehyde was given off after installation during the initial curing process, which typically took a few days to a week to complete. UFFI was sometimes improperly installed or used in locations where it should not have been, resulting in continued off-gassing of formaldehyde past the initial curing stage. Since UFFI was last installed in 1980, it should have little effect on indoor formaldehyde levels today. However, if UFFI comes in contact with water or moisture, it could begin to break down. Due to the age of the insulation UFFI may also begin to degrade and crumble into a fine powder. Under these conditions UFFI may release more formaldehyde and consideration should be given to removing the material using properly trained remediation personnel.

BIOLOGICAL HAZARDS

Mould

Mould is part of the fungi kingdom, which also includes mushrooms and yeasts. They are a naturally occurring and essential part of our environment since they break down dead organic material in the outdoor environment (such as leaves, wood and other plant debris), which they use as a food source.

Mould reproduces by means of tiny spores that are so small they can't be seen by the naked eye. Because of their small size mould spores easily become airborne and can travel long distances, entering indoor environments through ventilation systems, open windows or doors, or tracked in on footwear. Therefore, mould spores are a commonly detected in indoor air and as a component of settled dust.

Under normal conditions, the presence of indoor mould is not an issue. However, if conditions exist that allow it to grow and multiply indoors it can become a potential hazard. Several factors will affect what moulds will grow within a building and how fast they will grow. This includes parameters such as temperature, airflow, and the pH (i.e. acidity/alkalinity) of the food substrate. However, the most important parameter affecting mould growth is water availability, as all moulds need some amount of moisture for them to be able to grow. Buildings that have had a history of water damage are at greater risk of indoor mould growth.

Indoor mould growth may present a risk to the building structure itself through decomposition of building materials. Health risks to building occupants may also occur as

a result of indoor mould growth. Construction or renovation work which disturbs mould-contaminated materials increases this risk of exposure to building occupants and the construction workers themselves. Health effects associated with exposure to mould most commonly results in allergic type reactions such as runny nose, cough, congestion, eye irritation and aggravation of asthma, headache and fatigue. Exposure to very high concentrations of airborne mould spores (such as those that may be observed during disturbance of mould-contaminated building materials) can result in more serious health effects such as Organic Dust Toxic Syndrome (ODTS) or Hypersensitivity Pneumonitis (HP), where flu-like symptoms (fever, chills, cough, fatigue, shortness of breath, body aches, etc.) are exhibited. The chronic form of HP may occur from long-term exposure to lower levels of mould and results in a continued worsening in shortness of breath or cough. A variety of species of mould have also been documented to cause serious invasive infections, which are generally limited to individuals whose immune systems are already somehow compromised.

ENVIRONMENTAL HAZARDS

Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are a class of man-made organic chemicals known as chlorinated hydrocarbons. They vary in consistency from thin, light-coloured liquids to yellow or black waxy solids. They were manufactured in the United States from 1929 until their manufacture was banned in 1979. Although PCBs were not manufactured in Canada, they were imported from the U.S. over the years. Canada banned the import, manufacture and sale of PCBs in 1977.

PCBs are non-flammable, chemically stable over a wide range of temperature and physical conditions, not soluble in water, unaffected by acids, base or corrosive chemicals, and have a high dielectric or electrical insulating capacity. Due to these unique properties PCBs were used in hundreds of industrial and commercial applications, most commonly in electrical transformers and capacitors, including those capacitors found in light ballasts. They were also used as coolants, fire retardants and as insulation and in a number of other commercial applications including carbonless copy paper, dust suppressors for roads, hydraulic fluids, caulking compounds, plasticizers and lubricating oils and heat-transfer applications.

Although PCBs were found to be extremely useful in many industrial and commercial applications some of their chemical properties also made them an environmental and health hazard. PCBs are nearly indestructible and therefore persist if released into the natural environment. Their high fat and low water solubility result in a build-up (bioaccumulation) of PCBs in the fatty tissue of animals and humans if ingested/inhaled. Because PCBs persist in the fatty tissue of animals their concentration will tend to increase the higher up the food chain.

Most of what is known about the human health effects of PCBs is based on exposures due to accidental releases or job-related activities. These exposures are much higher than the levels normally found in the environment. The adverse health effects include a severe form of acne (chloracne), swelling of the upper eyelids, discolouring of the nails and skin, numbness in the arms and/or legs, weakness, muscle spasms, chronic bronchitis, and problems related to the nervous system. The International Agency for Research on Cancer (IARC) classifies PCBs as “probably carcinogenic to humans” (Group 2A) based on limited evidence that long-term, high-level occupational exposure can lead to increased incidence of liver and kidney cancers. The long-term impact of low-level exposures to PCBs that is common in the general population is unclear. The current state of knowledge suggests that low-level exposures to PCBs are unlikely to cause adverse health effects. However, people eating large amounts of certain sports fish, wild game and marine mammals are at increased risk for higher exposures and possible adverse health effects.

Ozone Depleting and Global Warming Substances

There are several different types of chemicals that are being or have been used as refrigerants in commercial, home and vehicle air conditioners and refrigerators or as fire extinguishing agents in portable and fixed fire extinguishing equipment. This includes groups of chemical compounds known as chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and halons. Some of these chemicals have also been used as foam blowing agents, as cleaning solvents for electrical components, as aerosol spray propellants, and in hospital sterilization procedures. Fixed halon fire extinguishing systems have historically been used in areas such as data centers, IT rooms, museums, libraries, surgical suites, and other locations where use of water-based suppressants could irreparably damage electronics or vital archival collections. There is a large number of halon fire extinguishing systems still in service in Canada.

The concern regarding past and present use of many of the chemicals used as refrigerants or fire extinguishing agents is that they are ozone-depleting substances (ODS). When released into the environment these chemicals break down in the stratosphere and release chlorine or bromine, which destroy the stratospheric ozone layer. The ozone layer screens the earth from some of the sun's harmful ultraviolet rays (UVB). As the ozone layer is depleted, higher UVB levels reach the earth, resulting in increased exposure to UVB. Increased exposure to UVB can cause skin cancer and plays a major role in malignant melanoma development. It can also increase the likelihood of cataracts and may also suppress proper functioning of the body's immune system and the skin's natural defenses.

CFCs, HCFCs and halons are also known to be greenhouse gases and contribute to global warming due to the build-up of these heat-trapping gases in the atmosphere. Hydrofluorocarbons (HFCs) are a common replacement chemical for CFC and HCFC



refrigerants; and although they do not have any ozone depleting potential they are a potent greenhouse gas.

Due to the ozone-depleting potential and/or global warming potential of CFCs, HCFCs, HFCs and halons it is important to control their use and emission into the environment. The manufacture and use of CFCs has stopped while transitional refrigerants (HCFCs) are scheduled to be phased out of production. No phase-out dates are currently planned for any HFCs. In Ontario, Regulation 463/10, "Ozone Depleting Substances and Other Halocarbons" (made under the Environmental Protection Act) enhances the control and management of substances that deplete the ozone layer and contribute to global warming. This regulation has requirements to prevent or minimize ozone-depleting substances and other halocarbons emissions, which serves a dual environmental benefit of lowering emissions that destroy the ozone layer and contribute to climate change.

Appendix 01 35 34B– Lead Report



CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: WT2507905		
Client	: Waterloo Region District School Board	Laboratory	: ALS Environmental - Waterloo
Contact	: Jeff Cull	Account Manager	: Candice Hunter
Address	: 51 Ardelt Avenue	Address	: 60 Northland Road, Unit 1
	: Kitchener Ontario Canada N2C 2E1		: Waterloo ON Canada N2V 2B8
Telephone	: 519 502 8343	Telephone	: +1 519 886 6910
Project	: ST. ANDREW'S P.S., CAMBRIDGE	Date Samples Received	: 10-Apr-2025 16:00
PO	: ----	Date Analysis Commenced	: 11-Apr-2025
C-O-C number	: 23-1119607	Issue Date	: 12-Apr-2025 04:57
Sampler	: Jeff Cull		
Site	: ----		
Quote number	: Non - Regulated Standing SOA		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Walt Kippenhuck	Supervisor - Inorganic	Metals, Waterloo, Ontario



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guidelines are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Key: CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.

LOR: Limit of Reporting (detection limit).

Unit	Description
mg/kg	milligrams per kilogram

>: greater than.

<: less than.

Red shading is applied where the result or the LOR is greater than the Guideline Upper Limit (or lower than the Guideline Lower Limit, if applicable).

For drinking water samples, Red shading is applied where the result for E.coli, fecal or total coliforms is greater than or equal to the Guideline Upper Limit.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Workorder Comments

<1 or Not Detected with LOR of 1 equals Zero (0).



SubMatrix: Paint Chips
(Matrix: Soil/Solid)

Please refer to the General Comments section for an explanation of any result qualifiers detected.

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CONTENTS :
(CONTENU)

DATE :
(DATE)

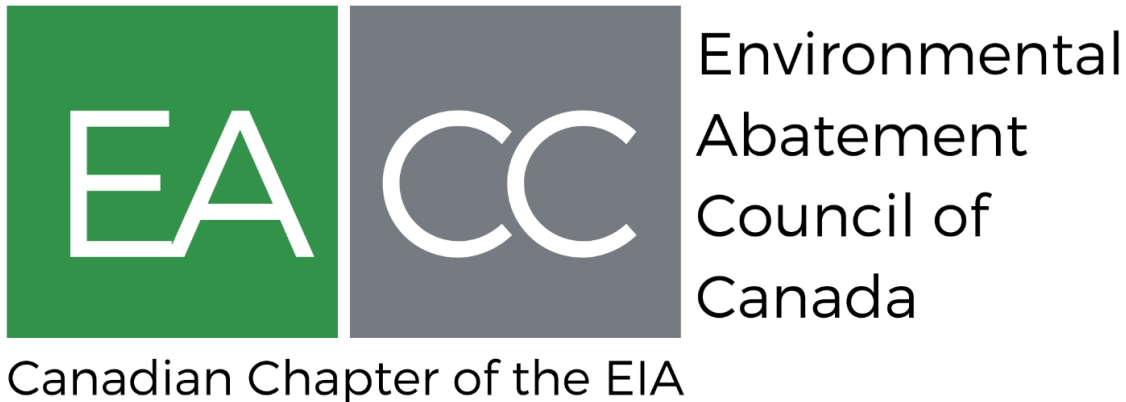


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For Construction, Renovation, Maintenance or Repair

October 2014



Foreword

This guideline has been prepared to assist building owners, constructors, contractors, subcontractors and workers who have duties under the Occupational Health and Safety Act and its Regulations to safely perform work activities involving lead, lead-containing or lead-contaminated materials. The guideline is intended to promote safe work practices, the use of appropriate personal protective equipment, worker awareness and training and is based in a thorough review of regulatory and guidance materials available to August 2014, as well as professional experience of the abatement industry in Ontario.

We believe that this guideline will not only help employers fulfill their responsibilities and due diligence, under the Occupational Health and Safety Act, but will also assist them to better address the challenges involved with implementing proper work procedures during activities involving lead, lead-containing or lead-contaminated materials.

Disclaimer

EACC disclaims any liability or risk resulting from the use of the work practices and recommendations discussed in the guideline. It is the user's responsibility to ensure that work practices and recommendations discussed in the guideline apply to specific workplaces and projects and to ensure compliance with all other applicable federal, provincial and local acts, codes and regulations.

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1. INTRODUCTION, GENERAL POINTS AND LIMITATIONS

1.1 Introduction

Interpretation and application of existing regulations and guidelines regarding lead are inconsistent within the construction and abatement industry, which impacts decisions regarding worker protection, occupant health and cost. Recognizing these issues, EACC has developed a guideline that transcends barriers between the assessment of lead in building materials and abatement and control procedures.

In this document, work on lead is defined as operations involving the handling, application, removal, disturbance or clean-up of Lead-Containing Materials (LCM) as defined in Appendix II and Section 3.2.

1.2 General Points

This guideline is intended for the environmental abatement industry, construction industry and the painting industry in general. The procedures identified herein are based on the current state of the science, practical experience and industry standard best-practices for lead abatement and dust control methods.

This guideline is not intended to address lead contamination in soil or in water.

1.3 Limitations

EACC is not responsible for the interpretation or use of the information contained within this document. It is the responsibility of the user to determine whether the information contained herein is appropriate to the user's specific activities. While EACC has attempted to identify and provide procedures for common scenarios, where lead abatement and control may be required, not all situations can be anticipated in advance. Therefore, the information contained within this document may not be suitable for all activities involving lead and caution should be used in applying the methods and procedures outlined in this document. Use professional judgement and if in doubt, contact a health and safety professional with experience in lead assessments and lead abatement operations.

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2. REGULATIONS AND GUIDELINES

2.1 Canadian Federal Limits for Lead in Paints and Surface Coatings

The Canadian Federal Government began limiting the amount of lead in certain new paints to 0.5% by weight (5,000 mg/kg, µg/g, parts per million [ppm]) in 1976. The Surface Coating Materials Regulation (SOR/2005-109) dated April 19, 2005, as amended, pursuant to the 2005 Hazardous Products Act, revised the standard to limit the amount of lead in certain paints to 0.06% (600 ppm). In October 2010, this was revised to 0.009 % (90 ppm). As detailed in the Surface Coating Materials Regulation (SOR/2005-109), paints and surface coatings manufactured for the following uses are excluded from the limitation on lead content:

- 1) as an anti-corrosive or an anti-weathering coating applied on the interior or exterior surface of any building or equipment that is used for an agricultural or industrial purpose;
- 2) as an anti-corrosive or an anti-weathering coating applied on any structure, other than a building, that is used for an agricultural, industrial or public purpose;
- 3) as a touch-up coating for metal surfaces;
- 4) on traffic signs;
- 5) for graphic art on billboards or similar displays;
- 6) for identification marks in industrial buildings; or
- 7) as material for the purposes of arts, crafts or hobbies, other than material for use by children (SOR/2010-224, s.1).

2.2 Ontario Regulation 490/09 – Designated Substances

This regulation applies to every employer and worker at a workplace where lead is present, produced, processed, used, handled or stored and at which a worker is likely to be exposed to lead.

2.3 Ministry of Labour Guideline – Lead on Construction Projects

This document is intended to assist persons who have duties under the Occupational Health and Safety Act, and its regulations, to protect workers from exposure to inorganic lead on construction projects.

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3. HISTORY OF LEAD AND LEAD USES

3.1 History

Lead has been commonly used for many industrial and commercial purposes for thousands of years, primarily because it is widely available, easy to extract and easy to work with. Lead is a naturally occurring heavy metal that is solid at room temperature and has a melting point of 327.5 degrees Celsius. Metallic lead has a bluish-white colour after being freshly cut and tarnishes to a dull gray when exposed to air. Lead was, and is, used in applications where low melting point, malleability and high density are useful.

3.2 Common Uses of Lead in Buildings

The following list includes the most common uses or application of lead in buildings. The list is not intended to be exhaustive.

- 1) Acoustic dampening baffles;
- 2) Additive in brass and other alloys;
- 3) Babbitt (bearing metal);
- 4) Batteries;
- 5) Cable and wire casing;
- 6) Cast iron pipe gaskets and connections;
- 7) Counterweights;
- 8) Decorative pieces;
- 9) Flashing;
- 10) Gaskets;
- 11) Glazing;
- 12) Indoor firing ranges;
- 13) Lead glass;
- 14) Late 19th and early 20th century tinted mortar at stone cladding;
- 15) Paint and surface coatings;
- 16) Pipes;
- 17) Radiation shielding (bricks or sheeting);
- 18) Solder (plumbing and electrical);
- 19) Stained glass and window came; and
- 20) Structural steel primer.

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3.3 Exposure Risks to Workers by Activity

Exposure to lead can result in almost any trade. Primarily, workers at highest risk for lead exposure include those involved in iron work, construction work, demolition, painting, plumbing, welding, heating and air conditioning work, building maintenance and repair work, electrical work and carpentry, renovation, and remodeling work.

Operations with the potential to expose workers to lead include, but are not limited to, the following list of activities where lead-containing materials are being disturbed. The list is not intended to be exhaustive.

- 1) Abrasive blasting;
- 2) Application or removal (e.g. by scraping, sanding) of lead-based or lead-containing paints and surface coatings;
- 3) Heat gun applications;
- 4) Lead burning;
- 5) Demolition, renovation or repair of structures where lead, lead-based or lead-containing paints or surface coatings are present;
- 6) Removing, repointing or disturbing lead-containing mortar;
- 7) Welding, high temperature cutting, torch cutting and burning of primed or painted steel structures;
- 8) Soldering;
- 9) Removing lead paint from bridges, structural steel and other materials; and
- 10) Installing or removing lead products (such as lead panels, lead sheeting and lead bricks used for shielding radiation sources).

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4. HAZARDS OF LEAD AND HEALTH EFFECTS

For the purpose of this document, lead refers to inorganic lead. Lead may affect the health of workers if it is in a form that may be inhaled or ingested. Inhalation of lead is considered the primary route of occupational exposure. When lead is present in the air as dust, fume or mist, it can be inhaled into the lungs and upper respiratory tract and then absorbed into the body. Incidental ingestion may occur when lead on work surfaces are transferred, to clothes and hands, and then to the mouth during eating, drinking, smoking, chewing or, touching of the face. Incidental ingestion may also occur when workplace surfaces are not properly cleaned, and good hygiene practices are not followed.

Lead exposure may occur in the form of dust (created through cutting, drilling, grinding, abrading, sanding, vibrating or polishing; as well as through activities related to renovation, demolition, repair or maintenance operations) or fume (created when lead is heated to temperatures above its melting point). Typically, temperatures above 500°C experienced during smelting, refining, welding and flame cutting or burning, are required before significant airborne concentrations of fumed lead are produced.

When lead is inhaled or ingested, it can enter the bloodstream and travel to soft tissues (such as the liver, kidneys, lungs, brain, spleen, muscles and heart). Some of this lead is filtered out of the body and excreted via urine, faeces, sweat and sloughing of dead skin. However, over time, lead in the body will move into the bones and teeth and can be stored there for a long time. Lead does not have a known function in the human body. It disrupts the function of enzyme systems that use other metals such as calcium, zinc and iron. Many of the health effects from lead take a long time to develop and may only become apparent after years of exposure.

Chronic exposure to small amounts of lead can result in a build-up of lead in the body over time, and the more lead in the body, the more likely that health problems will be experienced. Lead will naturally leave the body over time, but under conditions of continued exposure not all lead will be eliminated and will accumulate in body tissues and bone.

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4.1 Symptoms of Lead Exposure

Harmful effects can follow a high exposure over a short-term (acute exposure), or a low exposure over a long-term (chronic exposure).

Table 1: Symptoms and Adverse Health Effects of Lead Poisoning

Acute	• Abdominal cramps • Acute encephalopathy, a condition affecting the brain that develops quickly into seizures, coma, and death from cardiorespiratory arrest (extremely rare) • Constipation	• Diarrhea • Headaches • Irritability • Metallic taste in the mouth • Muscle and joint pain • Tiredness • Vomiting
Chronic	• Anemia, a low number of blood cells • Anxiety • Blue line on the gums • Colic with severe abdominal pain • Constipation • Damage or impairment to the reproductive systems • Damage to the blood forming system • Damage to the brain and kidneys • Damage to the nervous system • Damage to the urinary system • Dizziness • Excessive tiredness • Headaches • High blood pressure	• Hyperactivity • Impaired intellectual development, behaviour, size and hearing of infants. • Insomnia • Loss of appetite • Metallic taste in the mouth • Muscle and/or joint pain or soreness • Nausea • Nervous Irritability • Numbness • Pallor • Possible carcinogen (cancer causing) • Tremors • Weakness (including in fingers, wrists, or ankles) • Wrist drop (the inability to hold the hand extended)

Symptoms listed above should not be relied upon to warn of or to self-diagnose lead-exposure. Some workers may not exhibit a change in health and two workers with similar exposures may exhibit significantly different symptoms. Proper medical assessment and testing by a physician is the only way to assess health impacts due to lead exposure.

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Workers may carry lead-containing dust home on clothes, footwear, skin or hair, thereby increasing secondary exposure to themselves and potentially exposing family members to lead. The best approach in preventing lead exposure and lead poisoning is to be aware of its presence, ensure that proper engineering controls are in place and that control measures are properly implemented during the disturbance, handling, disposal and clean-up of lead and to follow proper worker hygiene (washing) procedures.

For additional information on the Health Effects of lead exposure, refer to “*Health Canada Final Human Health State of the Science Report on Lead*”, February 2013.

4.2 Blood Lead Level and Total Body Burden

Worker exposure to lead is assessed by two primary exposure indices: Blood Lead Level (BLL) and Lead in Mineralizing Tissues, specifically bones and teeth. Thirdly, some lead may also accumulate in soft body tissue (liver, kidneys, lungs, brain, spleen, muscles and heart). The sum of these indices is referred to as Total Body Burden (TBB). BLL is a measure of the amount of lead in the blood and can be used to determine if additional control measures are required or if workers require removal from a work environment. In order to help ensure lead levels in the body do not reach the point where removal from work or treatment is required, airborne lead exposure limits have been established to control the inhalation exposure to workers and proper hygiene procedures are used to control worker ingestion of lead.

5. OCCUPATIONAL EXPOSURE LIMITS

Employers are required by Ontario Regulation (O. Reg.) 833 “*Control of Exposure to Biological or Chemical Agents*” to limit the exposure of workers to specified hazardous biological or chemical agents in accordance with the values set out in the Regulation. In addition, O. Reg. 490/09 “*Designated Substances*” specifies worker exposure limits to lead. If a hazardous biological or chemical agent is not listed, the regulation prescribes the use of the exposure values set by the American Council of Governmental Industrial Hygienists (ACGIH). These values restrict the amount and duration of worker exposure to airborne concentrations of hazardous biological or chemical agents.

Currently, construction site projects are exempt from these regulations, however, under the occupational health and safety act general duty requirements, employers are required to do everything reasonable and practicable to protect workers from workplace hazards. Maintaining worker exposure within the prescribed occupational exposure levels is considered best management practice for construction workers.

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5.1 Airborne Lead Exposure Limits

Ontario Regulation 490/09

- 0.05 mg/m³ Time-Weighted Average (TWA)(8 hour day or 40 hour week).

Ontario Regulation 833

- 0.05 mg/m³ TWA(8 hour day or 40 hour week).

5.2 Rationale for Determination of De Minimis (i.e. virtually safe) Level

O. Reg. 490/09 and O. Reg. 833 prescribe time-weighted average (TWA) occupational exposure levels in Ontario for airborne lead in industry. The Ministry of Labour Guideline “Lead on Construction Projects” established measures and procedures for certain operations to protect worker health based on the type of work (lead operation being done) to maintain worker lead exposure within the TWA prescribed by O. Reg. 490/09 and O. Reg. 833. This guideline provides additional information and procedures for other activities, to enhance worker safety and assist in regulatory compliance.

Work activities involving lead are categorized by this guideline as Class 1, Class 2 or Class 3 Lead Operations. Classes of lead operations are defined in Section 7. Measures, procedures, controls and personal protective equipment requirements for each Class are provided in Section 8.

Various occupational and workplace safety authorities and agencies consider that, depending on the type of disturbance, airborne lead could be generated in hazardous levels from any amount of lead in a paint or surface coating. As such, these agencies have not set a level of lead in paint at which lead-related precautions are not required (a de minimis level). Similarly, there is no established concentration of lead below which lead procedures are not required if a lead-containing material is disturbed.

With no set level below which lead precautions are not required, lead precautions would be required when disturbing a material containing any measureable amount of lead. Several issues arise when abatement, construction repairs or maintenance are required:

- Lead is frequently present in low part per million concentrations in paints and surface coatings due to contaminants in the ingredients. Almost all coatings will be assumed to contain lead since it is not possible, using current analytical methods, to measure zero lead concentration. Therefore, no paint or surface coating can be said to be lead-free.

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- If any concentration of lead in paint or surface coating can create an airborne hazard, then every disturbance, including disturbance of new paint or surface coating (legally containing up to 0.009% lead) is a hazard. This implies that tasks such as new paint applications, drilling a hole through a painted surface, or cutting an opening in a painted surface, no matter how small, would be considered a lead operation.
- Nearly every construction or maintenance worker would disturb lead at some point. Therefore, each worker would require lead abatement training, medical surveillance, and every employer would require a respirator program.
- Since there is no Ontario exposure limit for lead exposures in construction, workers on construction sites may not be protected to the same extent as workers in other workplaces.

This guideline establishes a de minimis (i.e. virtually safe) level of lead in paint or surface coatings where a hazard would not likely be present. The following rationale applies to tasks that do not create excessive or significant dust, mist or fume. Tasks that generate significant dust, mist or fume are excluded and always require adherence to Class 2 or Class 3 operations or require an exposure assessment.

Considering:

- The Ontario TWA for lead is 0.05 mg/m³,
- The Ontario TWA for Particles Not Otherwise Specified (PNOS), sometimes termed “nuisance dust”, is 10 mg/m³ measured as inhalable dust; and
- The U.S. Environmental Protection Agency (EPA) and The Department of Housing and Urban Development (HUD) guideline states that a lead-based paint is any paint containing 0.5% lead (or 1 mg/cm² if measured by an X-Ray Fluorescence Analyzer (XRF)).

If a paint or surface coating containing 0.5% lead was made completely airborne, but not diluted by other dusts (i.e. if all of the paint was sanded off and made airborne and the substrate untouched), then the PNOS TWA would have to be exceeded in order for the lead TWA to be exceeded:

$$10 \text{ mg/m}^3 \text{ PNOS (nuisance dust)} \times 0.5\% \text{ lead} = 0.05 \text{ mg/m}^3 \text{ airborne lead} \\ \text{(which equals the TWA)}$$

If work is done on lead-containing paint or surface coatings (containing up to 0.5% lead) and the PNOS TWA is not exceeded then the Occupational Exposure Limit (OEL) for lead cannot be exceeded. This is conservative as some of the substrate would be expected to become airborne in most disturbances (e.g. power tool disturbance of paint on plaster or wood, hand or power sanding of painted wood).

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Similarly, if a painted surface with 0.25% lead was made completely airborne (and not diluted) then the TWA for lead could not be exceeded unless the TWA for PNOS was exceeded by at least a factor of two. This represents a concentration that is half the TWA (commonly called an action level) and, consistent with standard occupational hygiene practice, would not require respiratory protection.

The U.S. Occupational Safety and Health Administration (OSHA) has set 0.03 mg/m³ (30 µg/m³, TWA) as an action level:

The interim final standard establishes an action level of 30 micrograms of lead per cubic meter of air (30 µg/m³), averaged over an 8-hour workday. The action level triggers several ancillary provisions of the standard such as exposure monitoring, medical surveillance, and training.

Based on this approach OSHA does not require lead-specific precautions if the airborne exposure is below the action level. In this case, the non-lead portion of the paint (particulate matter) is the limiting hazard.

The Workplace Hazardous Material Information System (WHMIS) is enforced in all work places, and at less than 0.1%, an ingredient does not need to be listed on the Material Safety Data Sheet (MSDS). If a material containing less than 0.1% lead was to be made airborne then the TWA for PNOS would have to be exceeded by at least 5 times before the TWA for lead would be exceeded.

Lead content of 0.1% (i.e. 1000 µg/g or 1000 mg/kg or 1000 ppm lead) is considered a de minimis level of lead in paint or surface coatings, provided that aggressive disturbance or heating does not occur.

5.3 “De minimis” or “virtually safe” Lead Level for Paints and Coatings

For the purpose of this guideline:

- Paints or surface coatings containing less than or equal to 0.1% lead by weight (1000 µg/g or 1000 mg/kg or 1000 ppm lead) are considered low-level lead paints or surface coatings. If these materials (and the surfaces to which they are applied) are disturbed in a non-aggressive manner, performed using normal dust control procedures and are completed so that the TWA for PNOS is not exceeded, then worker protection from the inhalation of lead is not required. General health and safety precautions must still be implemented, which may include, in part, prohibiting eating, drinking, smoking and chewing in the work area, implementing dust suppression techniques and washing facilities for workers to wash hands and face.

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- Paints or surface coatings containing greater than 0.1% lead by weight (1000 µg/g, or 1000 mg/kg, or 1000 ppm) but less than 0.5% lead by weight (5000 µg/g, or 5000 mg/kg, or 5000 ppm lead) are considered lead-containing paints or surface coatings. Tasks performed that disturb these materials must be completed in accordance with the Classifications of Work Operations (in Section 7) and corresponding procedures (in Section 8). Alternatively, a hygiene or exposure assessment can be performed to determine procedures that are required.
- Regardless of lead content in paints or surface coatings, tasks that create an aggressive disturbance of coatings such as torching/welding, abrasive blasting must always be completed in accordance with the procedures listed in the Classifications of Work Operations (in Section 7) and corresponding procedures (in Section 8). Alternatively, a hygiene or exposure assessment can be performed to determine procedures that are required.
- Construction operations involving lead-based paints or surface coatings (i.e. concentrations equal to or greater than 0.5% lead by weight (5000 µg/g, or 5000 mg/kg, or 5000 ppm lead) must always be completed in accordance with the procedures listed in the Classifications of Work Operations (in Section 7) and corresponding procedures (in Section 8). Alternatively, a hygiene or exposure assessment can be performed to determine procedures that are required.

5.4 Blood Lead Monitoring and Medical Surveillance

Even with appropriate measures to control lead in the workplace, some workers may be occupationally and non-occupationally exposed. Periodic medical examinations are important for determining if the control measures in place are effective and being properly followed. Medical surveillance is a method of early detection of lead over exposure and assists in prevention of lead poisoning.

EACC recommends that all lead workers be tested for blood lead levels to properly document lead accumulation from all exposure sources including inhalation and ingestion. Testing for blood lead levels is recommended as follows.

- 1) Prior to starting to work with lead;
- 2) Immediately prior to long-duration lead abatement projects (regardless of Class);
- 3) Monthly during;
 - a. prolonged lead abatement projects (regardless of Class),
 - b. frequently completed lead operations (regardless of Class), or
 - c. Class 3 lead abatement projects.

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- 4) At the end of long-duration lead abatement projects (regardless of Class);
and
- 5) At least annually for workers involved in incidental lead work.

Consideration should also be given to additional project-specific testing for Class 2B or Class 3 Operations.

5.5 Blood Lead Guidelines

Blood lead level (BLL), is measured in micrograms of lead per decilitre of blood ($\mu\text{g/dL}$) or micromoles of lead per litre of blood ($\mu\text{mol/L}$).

The current Ontario Code for Medical Surveillance of Lead indicates the following limits:

- $> 70 \mu\text{g/dL}$ – remove from work
- $> 60 \mu\text{g/dL}$ – Action Level: enquiry regarding work practices & personal hygiene
- $\leq 50 \mu\text{g/dL}$ – acceptable for return to work
- $> 40 \mu\text{g/dL}$ – fertile woman must be removed from work

6. WORKER TRAINING

6.1 Training

Training is the first step in ensuring a safe and healthy workplace. It provides employers and workers with the knowledge required to protect themselves and others from injury and illness.

All workers involved in the disturbance or handling of lead-containing materials, or are otherwise exposed to lead, shall receive training.

Training shall be provided by a “Competent Person” as defined by the Occupational Health and Safety Act (OHSA) and ideally by an individual with lead identification and lead abatement training and experience.

The employer shall implement and document a training program for workers and ensure worker participation in the program. Training shall be completed for a worker conducting work which involves lead or may expose a worker to lead. Training shall be provided every 3 years at a minimum. For workers who conduct work that is routinely above the time-weighted average (TWA) for lead (i.e. Class 2 or Class 3 Operations), training shall be provided at least annually.

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At a minimum training shall include:

- a) Brief history of lead usage with a focus on lead in building materials,
- b) Review of Material Safety Data Sheets (MSDS),
- c) Review of the health hazards and illnesses association with lead exposure,
- d) Discussion on the health effects of lead on adults and children,
- e) Lead exposure symptom recognition,
- f) Description of how lead is stored in the body and can cause health effects later in life, and the limitations of blood lead monitoring,
- g) Explanation of routes of entry into the body including inhalation, ingestion and skin absorption. With attention paid to the risks associated with subsequent ingestion and the prohibiting of eating, smoking or chewing in the work area,
- h) Explanation of secondary exposure and exposure of family by taking contamination home on work clothing,
- i) The identification and nature of operations and activities that could result in lead exposure,
- j) Definition of the de minimis level for lead in paints and surface coatings and an explanation of its concept,
- k) Explanation of legislative exposure values for airborne lead,
- l) The purpose of Personal Protective Equipment (PPE), particularly coveralls and respirators,
- m) The selection, fitting, use, maintenance, and limitations of PPE,
- n) The proper donning (putting on) and doffing (taking off) and disposal of PPE,
- o) Review proper hand and face washing and hygiene techniques,
- p) The benefits of using indicator and chelating soaps and wipes to ensure adequate hand washing,
- q) The measures and procedures for various lead operations,
- r) The purpose and benefits of a medical surveillance program, and
- s) General non-lead hazards that may exist on lead projects.

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6.2 Training Requirements – Lead Awareness and Class 1 Operations

In addition to the requirements of sections 6.1:

- a) Lead Awareness Training shall be no less than four hours in duration,
- b) Workers shall be trained in the measures and procedures prescribed in Class 1 Operations (Section 7.1), and
- c) Proper waste classification and disposal in accordance with the Ontario Ministry of Environment Regulations.

6.3 Training Requirements – Class 2 and Class 3 Lead Operations

In addition to the requirements of section 6.2:

- a) Class 2 and Class 3 Lead Operations Training Program shall at a minimum be 1 day (7.5 hours) in classroom theory and shall include a practical hands-on training component,
- b) The employer shall ensure that every worker performing or involved with Class 2 and Class 3 Operations has successfully completed Lead Awareness Training and Class 2 and Class 3 Operations Training Program,
- c) Shall clearly define Class 2 and Class 3 Operations, and
- d) Proof of successful completion shall be issued to both the worker and employer in the form of a certificate.

NOTE: A worker certified with the 253H designation granted by the Ontario Ministry of Training Colleges and Universities (MTCU) is considered to have training equivalent to the requirements of Class 2 and Class 3 as stipulated in this guideline.

7. CLASSIFICATION OF WORK OPERATIONS

Each class of work specifies respirators, measures and procedures that shall be used and followed to protect workers and others from lead exposure. Work is classified based on the type of disturbance or activity that may cause lead exposure and/or the anticipated airborne concentration of lead. In this guideline, work involving lead is classified into three groups, Class 1, Class 2 and Class 3 Operations. Class 2 and Class 3 Operations are further subdivided. Airborne lead concentration typically increases as the classification increases.

NOTE: The application of a physical barrier (e.g. an encapsulant or new coat of paint) to a stabilized lead-containing material, or a paint or surface coating, is not considered a Lead Operation regardless of the concentration on lead in the underlying material. This also pertains to

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applying new low-lead level paints or surface coatings to lead-containing or lead-based paints or surface coatings (e.g. repainting).

7.1 Class 1 Operations

- a) Removal of lead-containing or lead-based paints and surface coatings with a chemical gel/stripper or paste.
- b) Application of lead-containing or lead-based paints and surface coatings with a brush, roller or sponge.
- c) Installation or removal of lead sheeting or flashing.
- d) Installation or removal of lead-containing packing, babbitt, caulking, gasket or similar material.
- e) Removal of materials coated with lead-containing or lead-based paints and surface coatings, using non-powered hand tools, where the material remains chiefly intact and is not crumbled, pulverized or powdered.
- f) Operating construction or demolition equipment (e.g. excavator, bulldozer) during building renovation or demolition where lead-based paints or surface coatings are present on building materials and are being disturbed.
- g) Soldering with lead solder.
- h) Removing lead-containing or lead-based paints or surface coatings with a heat gun.
- i) Removing lead-containing and lead-based paints and surface coatings using a high-pressure water jet (e.g. pressure washer).

7.2 Class 2 Operations

7.2.1 Class 2A Operations

- a) Removal of lead-containing or lead-based paints and surface coatings or lead-containing materials using a power tool that has an effective dust collection system¹ equipped with a HEPA filter.
- b) Welding, torching or high temperature cutting of lead-containing materials indoors when using an effective fume collector or smoke eater² that filters and exhausts lead fume and expels it directly outdoors (away from occupants, entrances, walkways, rest areas, etc.). Fume collector or smoke eater must have

¹ An effective dust collection system, which is an engineering control, that controls airborne lead concentration levels (measured on the worker) to below 0.05 mg/m³.

² An effective fume collection system/smoke eater, which is an engineering control, that controls airborne lead concentration levels (measured on the worker) to below 0.05 mg/m³.

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effective source control and capture velocity, minimum of 0.5 metres per second (100 feet per minute) at the work surface.

- c) Welding, torching or high temperature cutting of lead-containing and lead-based paints and surface coatings or lead-containing materials outdoors.
- d) Removal of lead-containing mortar using handheld non-powered tools.
- e) Removal of lead-containing and lead-based paints and surface coatings or lead-containing materials by scraping or sanding (including wet sanding) using non-powered hand tools.
- f) Demolition of plaster or building components that crumble, pulverize or powder and are covered with lead-containing or lead-based paints or surface coatings.
- g) Clean up and removal of a significant amount of lead-containing dust and debris (that can be made easily airborne) using wet methods or HEPA vacuums.

7.2.2 Class 2B Operations

- a) Spray application of lead-containing paints and surface coatings.

7.3 Class 3 Operations

7.3.1 Class 3A Operations

- a) Removal of lead-containing or lead-based paints and surface coatings or lead-containing materials using a power tool without an effective dust collection system equipped with a HEPA filter.
- b) Welding, torching or high temperature cutting of lead-containing materials indoors or in a confined space (e.g. within a ditch or pit).
- c) Removal of lead-containing mortar using a powered cutting device.
- d) Burning of a material containing lead.
- e) Removal, cleaning or repair of a ventilation system or ductwork used for controlling lead exposure.
- f) Spray application of lead-based paints and surface coatings.
- g) In the absence of an exposure assessment:
 - i. demolition or cleanup of a facility where lead-containing products were manufactured and significant dust and debris, which can be made easily airborne, is present.
 - ii. cleanup of dust and debris down range of a firing station in an indoor firing range.

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- iii. an operation that may expose a worker to lead dust, fume or mist that is not a Class 1, Class 2, or Class 3B operation.

7.3.2 Class 3B Operations

- a) Abrasive blasting of lead-containing and lead-based paints and surface coatings or lead-containing materials (including wet, slurry and dry abrasive blasting and dry-ice blasting).

7.4 Alternate Work Classification Method

Alternatively, the classification of Lead Operations during construction can be based on airborne concentrations.

Table 2: Determination of Class by Airborne Lead Concentration

Class 1 Operations	Class 2 Operations		Class 3 Operations	
	Class 2a	Class 2b	Class 3a	Class 3b
0.025 to 0.05 mg/m ³	>0.05 to 0.50 mg/m ³	>0.50 to 1.25 mg/m ³	>1.25 to 2.50 mg/m ³	>2.50 mg/m ³

Procedures that generate airborne lead at concentrations below 0.025 mg/m³ do not require the use of lead procedures or personal protective equipment, however general health and safety precautions must still be implemented, which may include, in part, prohibiting eating, drinking, smoking and chewing in the work area, implementing dust suppression techniques and establishing washing facilities for workers to wash hands and face.

Determination of airborne lead concentrations can be made by conducting a negative exposure assessment consistent with the principles of the American Industrial Hygiene Association (AIHA), “Strategy for Assessing and Managing Occupational Exposures”. The assessment will measure the airborne lead concentrations during a specific work activity, under specific conditions, while implementing control measures detailed in Section 8. The assessment may demonstrate that engineering controls and other preventive measures are maintaining airborne concentrations of lead within an acceptable exposure range. This proof of exposure control can be used to classify a specific activity or to justify the use of alternative lead-specific precautions pertaining to an existing Class. In order to determine (or reduce) the Classification of a work operation, a negative exposure assessment shall be completed and must include worker personal air monitoring.

Local exhaust ventilation, dust collectors, enclosures or other engineering controls may be used to reduce airborne lead concentrations and reduce the measures and

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procedures prescribed in the applicable Class. An exposure assessment shall be performed to ensure the effectiveness of the controls.

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8. ENGINEERING CONTROLS, PROCEDURES AND HYGIENE

8.1 Planning

An evaluation of the site shall be completed by a competent person to identify classes of work and prepare a plan to satisfy site specific requirements.

8.2 Inspections

A pre-start inspection shall be completed by a competent person. The purpose of this inspection is to ensure and document that the prescribed measures are established and acceptable prior to the start of any work that will disturb lead. The following are minimum inspection requirements:

- a) An inspection of the work area signage and containment, if applicable.
- b) An inspection of the equipment.
- c) An inspection of the hygiene facilities and intended procedures.
- d) An inspection of ventilation controls, if applicable.

Routine inspections must be scheduled while the lead operations are ongoing to ensure and document that the prescribed measures remain in-place and the prescribed procedures are being followed.

Prior to each shift, a competent person shall inspect the work area, any enclosures and washing facility or decontamination facility for defects or deficiencies. All defects and deficiencies shall be corrected before work resumes. The decontamination facility shall be maintained in a clean and sanitary condition.

8.3 General Principles

The strategy for controlling airborne lead hazard is broken down into following basic principles:

- a) Worker education,
- b) Prevent lead from becoming airborne,
- c) Prevent airborne lead from spreading,
- d) Remove airborne lead,
- e) Prevent workers from inhaling airborne lead and or ingesting lead, and
- f) Adequate cleaning to control exposure to lead residue.

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To avoid the ingestion, inhalation and unintentional transfer of lead from contaminated areas, it is essential to have the following control methods in place:

- a) Engineering controls,
- b) Work practices,
- c) Hygiene practices, and
- d) Protective clothing and equipment.

8.4 Engineering Controls

Workplace stakeholders, which may include owners, constructors, contractors, specification writers, supervisors and workers, involved in construction projects that may expose workers to lead should:

- a) Substitute lead-containing materials with low lead content (or materials described commercially as lead-free) alternatives where possible.
- b) Select methods and equipment for the removal or installation of lead-containing materials that will reduce dust generation (e.g. wet methods, such as wet sweeping and shovelling) and shall be used whenever practicable.
- c) Provide general mechanical ventilation to remove contaminated air from the workplace. The replacement air entering the work area must be free from contamination with any hazardous dust, mist, fume, vapour, or gas.
- d) Provide local mechanical ventilation to remove dust, mist and fumes at the source whenever possible. Local mechanical ventilation shall have adequate capture velocity at the source of generation to control worker exposure to dust mist and fumes containing lead. The following should be met.
 - i. Cross draft 0.5 metres per second (100 feet per minute), and
 - ii. Down draft 0.25 metres per second (50 feet per minute).
- e) Unless working in a Class 3 enclosure, power tools used to remove lead-containing paints and surface coatings shall be equipped with an effective dust collection systems attached to HEPA Filters. The dust shroud shall be kept flush with the surface from which the paint or surface coating is being removed.

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8.5 Work and Hygiene Practices

Work practices, personal protective equipment and hygiene practices are on-the-job activities that reduce exposure to lead. Lead-containing material can accumulate on the hands, clothing and hair and when disturbed, can be re-suspended in air and inhaled or ingested. Personal protective clothing and equipment for each Class of lead operation is described in Section 9. Workers shall decontaminate at the end of each shift. The specific washing and decontamination facilities that shall be provided for lead work are detailed in Section 10. For all work with the potential for lead exposure, there shall be no smoking, eating, drinking or chewing in contaminated areas. Food, beverages and tobacco products shall be left outside the work area.

An effective housekeeping program requires regular clean-up and removal of lead-containing dust and debris. Surfaces shall be kept clean by washing down with water or cleaning with a vacuum equipped with a HEPA filter. Lead waste containers shall be kept tightly covered (dust tight) to prevent dust from becoming airborne. Cleaning with compressed air or dry sweeping shall not be performed.

8.6 Measures and Procedures for Class 1, Class 2 and Class 3 Operations

This section of the guideline outlines the general measures and procedures for all work with lead-containing materials, followed by specific minimum recommendations for Class 1, Class 2 and Class 3 operations.

8.6.1 Class 1 Operations

- a) Washing facilities consisting of a wash basin, clean water, soap (consider the use of lead-specific soaps and hygiene indicators based on the scope of the Operation) and towels shall be provided. Workers shall use these washing facilities upon leaving the work area and before eating, drinking or smoking.
- b) Respirators should not be necessary if all general health and safety procedures are followed. However, any worker who requests a respirator shall be provided with a respirator, as prescribed in Table 3, and the worker shall wear the respirator.
- c) Coveralls should not be necessary if all general health and safety procedures are followed. However, any worker who requests coveralls shall be provided with coveralls, as prescribed in Section 9, and the worker shall wear the coveralls.
- d) Gloves shall be provided, as prescribed in Section 9, and the worker shall wear the gloves.
- e) Use removal methods that minimize dust generation whenever possible.
- f) Suppress any dust generated.
- g) Workers shall not eat, drink, chew or smoke in the work area.

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- h) Dust and waste shall be cleaned up at regular intervals and placed in a container that is;
 - i. dust tight,
 - ii. suitable for the type of waste,
 - iii. identified as lead waste,
 - iv. cleaned with a damp cloth or a vacuum equipped with a HEPA filter, or placed in a clean bag so that a clean exterior surface is achieved immediately prior to removal from the work area,
 - v. removed from the workplace frequently and at regular intervals, and
 - vi. evaluated for lead-content and disposed of in accordance with applicable regulations.
- i) The use of 6 mil polyethylene bags as a waste container is acceptable provided it is appropriate for the type of waste. Double bagging of waste is recommended.
- j) Drop sheets shall be used below all lead operations that may produce dust, chips, or debris containing lead.
- k) Dry removal of lead-containing or lead-based paints and surface coatings shall be minimized whenever possible.
- l) Wetting of materials shall be conducted whenever possible to control dust. The addition of wetting agents should be considered. Wetting should not be used if it may create a hazard or cause damage.
- m) Wet methods should be incorporated in the operation to reduce dust generation. Examples of wet methods include wetting surfaces, wet mist, wet scraping and wet shovelling.
- n) Cleaning with compressed air or dry sweeping shall not be performed. Sweeping compounds shall be used where wetting is not possible.
- o) All equipment, tools, respirators and clothing shall be cleaned by damp wiping, or with a vacuum equipped with a HEPA filter, prior to removal from the work area.
- p) Protection of porous or fibrous surfaces is imperative as it is very difficult to remove lead-containing dust from these surfaces. If the material cannot be adequately protected from lead dust or waste it shall be removed and disposed of.
- q) Any water generated from cleaning or removal operations must be appropriately contained, treated or disposed of in accordance with applicable legislation.

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- r) Follow worker hygiene procedures as prescribed in Section 10.

8.6.2 Class 2 Operations

- a) Washing facilities consisting of a wash basin, clean water, soap (consider the use of lead-specific soaps and hygiene indicators based on the scope of the Operation) and towels shall be provided. Workers shall use these washing facilities upon leaving the work area and before eating, drinking or smoking.
- b) Respirators shall be provided, as prescribed in Table 3, and the worker shall wear the respirator.
- c) Gloves, coveralls and other Personal Protective Equipment (PPE) shall be provided, as prescribed in Section 9, and the worker shall wear the PPE.
- d) Signage is required and the area shall be delineated to control access. Signs shall be posted in sufficient numbers to warn of the lead hazard and shall state in large clearly visible letters that, i) there is a lead hazard, and ii) Access to the work area is restricted to persons wearing protective clothing.
- e) Use removal methods that minimize dust generation whenever possible.
- f) Suppress any dust generated.
- g) Workers shall not eat, drink, chew or smoke in the work area.
- h) Dust and waste shall be cleaned up at regular intervals and placed in a container that is;
 - i. dust tight,
 - ii. suitable for the type of waste,
 - iii. identified as lead waste,
 - iv. cleaned with a damp cloth or a vacuum equipped with a HEPA filter, or placed in a clean bag so that a clean exterior surface is achieved immediately prior to removal from the work area,
 - v. removed from the workplace frequently and at regular intervals, and
 - vi. evaluated for lead-content and disposed of in accordance with applicable regulations.
- i) The use of 6 mil polyethylene bags as a waste container is acceptable provided it is appropriate to the type of waste. Double bagging of waste is recommended.
- j) Drop sheets shall be used below all lead operations that may produce dust, chips, or debris containing lead.
- k) Air-handling (supply and return) systems servicing the area of the Class 2 Operation shall be removed from service or isolated to prevent migration of lead through the air handling system.

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- l) Dry removal of lead-containing or lead-based paints and surface coatings shall be minimized whenever possible.
- m) Wetting of materials shall be conducted whenever possible to control dust. The addition of wetting agents should be considered. Wetting should not be used if it may create a hazard or cause damage.
- n) Wet methods shall be incorporated in the operation to reduce dust generation. Examples of wet methods include wetting surfaces, wet mist, wet scraping and wet shovelling.
- o) Cleaning with compressed air or dry sweeping shall not be performed. Sweeping compounds shall be used where wetting is not possible.
- p) All equipment, tools, respirators and clothing shall be cleaned by damp wiping, or using a vacuum equipped with a HEPA filter, prior to removal from the work area.
- q) Protection of porous or fibrous surfaces is imperative as it is very difficult to remove lead-containing dust from these surfaces. If the material cannot be adequately protected from lead dust or waste it shall be removed and disposed of.
- r) Any water generated from cleaning or removal operations must be appropriately contained, treated or disposed of in accordance with applicable legislation.
- s) Where a dust generating operation is carried out, additional local mechanical ventilation shall be provided to remove dust, mist and fumes at the source. Local mechanical ventilation is recommended for welding, burning or high temperature cutting and for the removal of lead-containing and lead-based paints and surface coatings using power tools that are equipped with a dust collection device attached to a HEPA filter. Where local mechanical ventilation is used, the following should be met:
 - i. Air velocity at the source of dust, mist or fume generation shall be no less than 0.5 m/sec (100 ft./min).
 - ii. Air discharged from the local mechanical ventilation system shall pass through a HEPA filter.
- t) Follow worker hygiene procedures as prescribed in Section 10.

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8.6.3 Class 3 Operations

- a) A competent supervisor must be present at all times during Class 3 Operations. Only workers and supervisors with proper training shall perform Class 3 Operations.
- b) Washing facilities consisting of a wash basin, clean water, soap (consider the use of lead-specific soaps and hygiene indicators) and towels shall be provided. Workers shall use these washing facilities upon leaving the work area and before eating, drinking or smoking.
- c) Respirators shall be provided, as prescribed in Table 3, and the worker shall wear the respirator.
- d) Gloves, coveralls and other PPE shall be provided, as prescribed in Section 9, and the worker shall wear the PPE.
- e) Signage is required and the area shall be delineated to control access. Signs shall be posted in sufficient numbers to warn of the lead hazard and shall state in large clearly visible letters that, i) there is a lead hazard, and ii) access to the work area is restricted to persons wearing protective clothing.
- f) Use removal methods that minimize dust generation whenever possible.
- g) Suppress any dust generated.
- h) Workers shall not eat, drink, chew or smoke in the work area.
- i) Dust and waste shall be cleaned up at regular intervals and placed in a container that is,
 - i. dust tight,
 - ii. suitable for the type of waste,
 - iii. identified as lead waste,
 - iv. cleaned with a damp cloth or a vacuum equipped with a HEPA filter, or placed in a clean bag so that a clean exterior surface is achieved immediately prior to removal from the work area,
 - v. removed from the workplace frequently and at regular intervals, and
 - vi. evaluated for lead-content and disposed of in accordance with applicable regulations.
- j) The use of 6 mil polyethylene bags as a waste container is acceptable provided it is appropriate for the type of waste. Double bagging of waste is recommended.

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- k) Enclosures shall be used to separate the work area from other construction activities or work areas, and to prevent lead exposure to persons not directly involved in the lead operation. Barriers should only be used where full and partial enclosures are not practicable.
- u) Drop sheets shall be used below all lead operations that may produce dust, chips, or debris containing lead.
- l) For Class 3a operations conducted indoors where work areas are not accessible to the public, barriers, partial enclosures, or full enclosures may be used.
- m) For all other all other Class 3 operations conducted indoors full enclosures shall be used.
- n) For Class 3a and 3b operations conducted outdoors, barriers, partial enclosures, or full enclosures shall be provided.
- o) ***Barriers, Partial Enclosures and Full Enclosures***
 - i. Ropes or barriers do not prevent the release of contaminated dust or other contaminants into the environment. However, barriers can be used to restrict access to only workers who are adequately protected with proper PPE, and prevent entry of individuals not directly involved in the operation. Ropes or barriers shall be placed at a distance far enough from the operation that allows the lead-containing dust to settle. If this is not achievable, warning signs shall be posted at the distance where the lead-containing dust settles to warn that access is restricted to persons wearing PPE. Ropes or barriers shall be located no less than 10 metres from the work area.
 - ii. Partial enclosures may consist of vertical and/or horizontal tarps and drop sheets (e.g. polyethylene sheeting). The tarps shall overlap and be securely fixed together at the seams. A partial enclosure is not a recommended containment system if significant dust is being generated, however is suitable for containing flakes and chips.
 - iii. Full enclosures are tight enclosures (with tarps that are generally impermeable (e.g. polyethylene sheeting) with fully sealed joints and chambered air lock entryways/exits and upper seals). Full enclosures allow minimal or no fugitive emissions to reach the area outside the enclosure. For full enclosures, the following requirements shall be met:
 - a) The enclosure shall be made of windproof materials that are impermeable to dust.
 - b) The enclosure shall be supported by a secure, adequate and safe structure.
 - c) All joints in the enclosure shall be fully sealed.

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- d) Entrances to the enclosure shall be equipped with air locks (curtain walls, flap doors, zipper doors or solid doors).
- e) The escape of dust, mist, fume, waste, blast media and debris from the enclosure shall be prevented.
- f) General mechanical ventilation shall be provided by a HEPA filtered unit to remove contaminated air from the enclosure. Clean and safe make-up air that is free from hazardous dust, mist, vapours or fumes shall be provided to replace the exhausted air.
- g) Filters used on ventilation equipment shall be adequate to ensure that exhausted air quality meets applicable environmental legislation and standards.
- h) The air velocity within the enclosure shall provide an average minimum cross-draft or down-draft past each worker during abrasive blasting operations as follows.
 - cross draft capture velocity of 0.5 m/sec (100 ft./min) at the worker breathing zone.
 - Down draft capture velocity of 0.25 m/sec (50 ft./min) at the worker breathing zone.
- p) The spread of lead dust from the work area shall be prevented by creating and maintaining within the enclosed area a minimum negative air pressure of 0.02 inches of water column (5 pascal), relative to the area outside the enclosed work area and/or 6 air changes per hour. Pressure differential readings must be taken and logged at regular intervals during lead removal.
- q) Air-handling systems (supply and return) servicing the area of the Class 3 Operation shall be removed from service or isolated to prevent migration of lead through the air handling system.
- r) Dry removal of lead-containing or lead-based paints and surface coatings shall be minimized whenever possible.
- s) Wetting of materials shall be conducted whenever possible to control dust. The addition of wetting agents should be considered. Wetting should not be used if it may create a hazard or cause damage.
- t) Wet methods shall be incorporated in the operation to reduce dust generation. Examples of wet methods include wetting surfaces, wet mist, wet scraping and wet shovelling.
- u) Cleaning with compressed air or dry sweeping shall not be performed. Sweeping compounds shall be used where wetting is not possible.

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- v) All equipment, tools, respirators and clothing shall be cleaned by damp wiping, or using a vacuum equipped with a HEPA filter, prior to removal from the work area.
- w) Protection of porous or fibrous surfaces is imperative as it is very difficult to remove lead-containing dust from these surfaces. If the material cannot be adequately protected from lead dust or waste it shall be removed and disposed of.
- x) Any water generated from cleaning or removal operations must be appropriately contained, treated or disposed of in accordance with applicable legislation.
- y) Where a dust generating operation is carried out, additional local mechanical ventilation shall be provided to remove dust, mist and fumes at the source. Local mechanical ventilation is recommended for welding, burning or high temperature cutting and for the removal of lead-containing and lead-based paints and surface coatings using power tools that are not equipped with a dust collection device attached to a HEPA filter. Where local mechanical ventilation is used, the following should be met:
 - i. Air velocity at the source of dust, mist or fume generation shall be no less than 0.5 m/sec (100 ft./min).
 - ii. Air discharged from the local mechanical ventilation system shall pass through a HEPA filter.

Class 3 Decontamination Facility

Establishing a decontamination facility is required for workers conducting Class 3 operations. The decontamination facility shall be located as close as practicable to the work area and shall consist of:

- a) A suitable area for taking off contaminated protective clothing.
- b) A shower that includes;
 - i. Hot and cold water with individual controls inside the room to regulate water flow and temperature; or
 - ii. Water of a constant temperature that is not less than 40° Celsius or more than 50° Celsius.
 - iii. Clean towels.
 - iv. Soap that is suitable for removing lead, and
 - v. Hygiene indicators to visually confirm that lead has been removed from workers hands.

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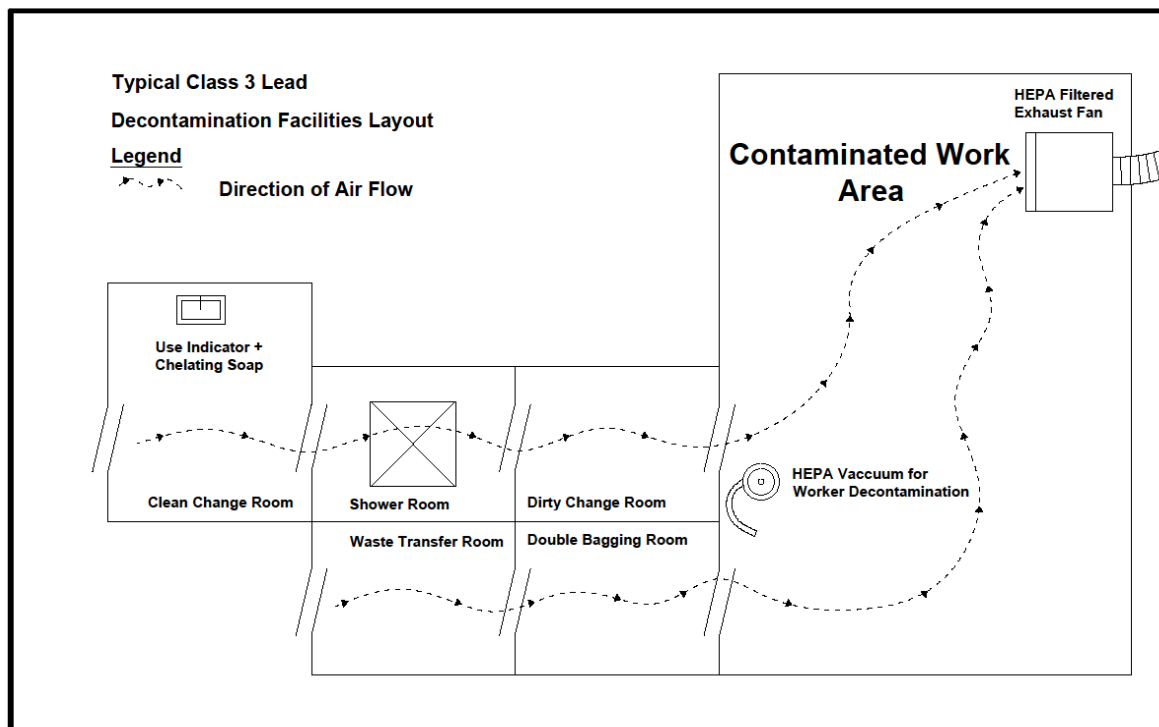
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- c) a suitable area for changing in to street clothes and for storing clean clothing and equipment
- d) Follow worker hygiene procedures as prescribed in Section 10.

Refer to Figure 1 as an example of a typical Class 3 Lead Operation decontamination facility layout.

Figure 1: Typical Class 3 Lead Operation Decontamination Facilities Layout



9. PERSONAL PROTECTIVE EQUIPMENT

Employers must ensure workers who are involved in Lead Operations, are provided with appropriate personal protective equipment (PPE) including:

- a) Dust-impermeable gloves appropriate for the work being completed and disposable chemical resistant gloves for application of solvents, strippers and detergents. Refer to the Material Safety Data Sheets (MSDS) for recommended glove selection. Consideration should be given to wearing two layers of gloves in high lead exposure operations to reduce contaminant transfer during removal of protective clothing.
- b) Full body coveralls made of a material that does not readily retain nor permit penetration of lead, is equipped with a hood or head covering, and that fits

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snugly at the ankles, wrists and neck, in order to prevent lead dust from reaching the garments and skin under the protective clothing. Coveralls shall be repaired or replaced if torn. Suitable footwear or coverings shall be worn.

c) Respirators as prescribed by Table 3.

The following table indicates anticipated airborne concentrations of lead, associated with each Class of lead operation, with the corresponding minimum recommended respiratory protection. Respirators shall be NIOSH approved and the worker shall be fit-tested for the specific type and size of respirator.

Table 3: Lead-Specific Personal Protective Equipment

Class 1 Operation	Minimum Respirator Requirement	Lead-Specific PPE
(0.025 - 0.05 mg/m ³)	Respirators should not be necessary if the general procedures listed in Section 8 are followed and if the level of lead in the air is less than 0.05 mg/m ³ . If a worker requests to wear a respirator, a half-face air purifying respirator with N-, R- or P- series filters, and 95, 99 or 100% efficiency shall be provided.	Appropriate gloves. If a worker requests, coveralls, boot covers and respirator shall be provided.
Class 2a Operation	NIOSH APF = 10	
(>0.05 to 0.50 mg/m ³)	Half-face air purifying respirator with N-, R- or P-series filter, and 95, 99 or 100% efficiency.	Appropriate gloves, coveralls and boot covers, respirator
Class 2b Operation	NIOSH APF = 50	
(>0.50 to 1.25 mg/m ³)	Full-face piece air-purifying respirator with N-, R- or P- series filter, and 100% efficiency.	Appropriate gloves, coveralls and boot covers, respirator
Class 3a Operation	NIOSH APF = 50	
(>1.25 to 2.50 mg/m ³)	Full-face piece air-purifying respirator with N-, R- or P- series filter, and 100% efficiency. Tight-fitting powered air-purifying respirator with a high efficiency filter. Full-face piece supplied-air respirator operated in demand mode. Half-mask or full-face piece supplied air respirator operated in continuous-flow mode.	Appropriate gloves, coveralls and boot covers, respirator
Class 3b Operation	NIOSH APF ≥ 1000	
(> 2.50 mg/m ³)	Type CE abrasive-blast supplied air respirator operated in a positive pressure mode with a tight-fitting half-mask face piece.	Appropriate gloves, coveralls and boot covers, respirator

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	Full-face piece supplied-air respirator operated in pressure-demand or other positive-pressure mode.	

NIOSH APF – National Institute of Occupational Safety and Health Assigned Protection Factor.

Compressed air systems used with supply air respirators shall meet the requirements of CSA Standard Z180.1-13.

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10. WORKER HYGIENE PROCEDURES

Good hygiene practices must be implemented during lead-related work to protect the worker from lead exposure. Every Class of lead work requires that workers thoroughly wash hands and face when leaving the work area and prior to eating, drinking, smoking or chewing. Proper hand washing techniques specific to lead decontamination shall be posted in the washing facility and products including lead specific hand soaps which combine surfaction, chelation, pH adjustment and mechanical removal of lead from the skin may be used. The use of post washing indicator methods that demonstrate workers have adequately removed lead from skin is strongly recommended.

Using lead wipe indicators will help the worker identify if washing was effective in removing lead. Standard soap and water alone may not be effective at removing lead from skin which can result in secondary exposure by ingestion.

10.1 Class 1 Operations

10.1.1 Decontamination and Personal Hygiene Facilities

- a) Clean change areas with lockers or hangers and hooks for workers' street clothes and personal belongings. The Clean Room will also have a mirror to permit workers to fit respiratory equipment properly.
- b) The Clean Area will accommodate at least one worker allowing sufficient space to change comfortably.
- c) A clean lunch/break area will be provided and kept as free as practicable of lead contamination.

10.1.2 Entering the Work Area

Workers will use the following sequence when entering the work area:

- a) Remove street clothes, if required.
- b) Don appropriate PPE, as prescribed in Table 3, before entering the work area.

10.1.3 Exiting the Work Area

- a) Remove gross contamination from coveralls, if worn, person and personal protective equipment by wet wiping, and/or using a vacuum equipped with a HEPA filter, before leaving Work Area.
- b) If worn, remove coveralls while minimizing contact with undergarments or body (i.e. by removing coveralls downwards and outwards while rolling onto itself).
- c) Proceed to decontamination facility to wash hands and face.

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- d) Washing procedure should be similar to the following sequence.
 - i. Wet hands and face (and respirator if worn) with water.
 - ii. Apply soap to cover hand surface.
 - iii. Rub palm to palm, back of the hands, and in between fingers for 15-20 seconds.
 - iv. Wash and rinse face (and respirator if worn).
 - v. Remove respirator if worn.
 - vi. Wash face, ensuring all surfaces cleaned including ears and neck.
 - vii. Rinse hands and face with running water.
 - viii. Dry hands with a single use towel.
 - ix. Turn off faucet with the towel and dispose of the towel.

10.2 Class 2 Operations

10.2.1 Decontamination and Personal Hygiene Facilities

- a) Clean change areas with lockers or hangers and hooks for workers' street clothes and personal belongings. The Clean Room will also have a mirror to permit workers to fit respiratory equipment properly.
- b) The Clean Area will accommodate at least one worker allowing sufficient space to change comfortably.
- c) A clean lunch/break area will be provided and kept as free as practicable of lead contamination.

10.2.2 Entering the Work Area

Workers will use the following sequence when entering the work area:

- a) Remove street clothes, if required.
- b) Don appropriate PPE, as prescribed in Table 3, before entering the work area.

10.2.3 Exiting the Work Area

- a) Remove gross contamination from coveralls, if worn, person and personal protective equipment by wet wiping, and/or using a vacuum equipped with a HEPA filter, before leaving Work Area.
- b) If worn, remove coveralls while minimizing contact with undergarments or body (i.e. by rolling coveralls downwards and inwards into it).
- c) Leave respirator on and place contaminated disposable PPE in waste container.
- d) Wash hands, face, and respirator prior to respirator removal then wash face and hands again before leaving the work area.

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- e) Washing procedure should be similar to the following sequence.
 - i. Wet hands, face and respirator with water.
 - ii. Apply soap to cover hand surface.
 - iii. Rub palm to palm, back of the hands, and in between fingers for 15-20 seconds.
 - iv. Wash and rinse face and respirator.
 - v. Remove respirator.
 - vi. Wash face, ensuring all surfaces are cleaned including ears and neck.
 - vii. Rinse hands, face and respirator with running water.
 - viii. Dry hands and face with a single use towel.
 - ix. Turn off faucet with the towel and dispose of the towel.
- f) Don street clothes in Clean Room prior to leaving work site.
- g) Upon completion of lead abatement, dispose of shoe coverlets as contaminated waste or clean thoroughly inside and out using lead-specific soap and water, and test with lead indicator wipes before removing from the Work Area.

10.3 Class 3 Operations

10.3.1 Decontamination and Personal Hygiene Facilities

- a) Establish a decontamination facility in accordance with Section 8.
- b) A clean lunch/break area will be provided and kept as free as practicable of lead contamination.

10.3.2 Entering the Work Area

Workers will use the following sequence when entering the work area:

- a) Remove street clothes, if required.
- b) Don appropriate PPE, as prescribed in Table 3, before entering the work area.
- c) Proceed through the shower facility.
- d) Don reusable PPE that remains in the 'dirty change area'.

10.3.3 Exiting the Work Area

- a) Remove gross contamination from coveralls, if worn, person and personal protective equipment by wet wiping, and/or using a vacuum equipped with a HEPA filter, before leaving Work Area.
- b) If worn, remove coveralls while minimizing contact with undergarments or body (i.e. by rolling coveralls downwards and inwards into itself).

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- c) Leave respirator on and place contaminated disposable PPE in waste container. Shower without removing the respirator and clean respirator while in the shower.
- d) Proceed to clean room, remove cleaned respirator and store in a sealed plastic bag/container.
- h) Washing procedure, prior to leaving the clean room, should be similar to the following sequence.
 - i. Wet hands, face and respirator with water.
 - ii. Apply soap to cover hand surface.
 - iii. Rub palm to palm, back of the hands, and in between fingers for 15-20 seconds.
 - iv. Wash and rinse face and respirator.
 - v. Remove respirator.
 - vi. Wash face, ensuring all surfaces are cleaned including ears and neck.
 - vii. Rinse hands, face and respirator with running water.
 - viii. Dry hands and face with a single use towel.
 - ix. Turn off faucet with the towel and dispose of the towel.
- e) Don street clothing before leaving the work area

11. WORK AREA CLEANING PROCEDURES

The following final cleaning procedures are minimum requirements. Additional final cleaning procedures may be necessary to meet project-specific requirements.

11.1 Class 1 Operations

- a) Cleaning shall be completed in a top-to-bottom methodology (i.e. start in high locations and clean down towards floor level) and beginning at the farthest point of the work area from the entrance (i.e. clean towards the entrance to the work area).
- b) Compressed air or dry sweeping shall not be used to clean the work area.
- c) Clean all surfaces in the work area by wet wiping and/or using a vacuum equipped with a HEPA filter.

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- d) When using wet wipe cleaning, frequently and at regular intervals,
 - i. Use folding technique to expose a clean surface of the cloth.
 - ii. Rinse cloth with clean water.
 - iii. Replace soiled cloth with clean cloth.
 - iv. Replace dirty water with clean water.
- e) Clean and rinse a small area at a time before proceeding to the next area.
- f) Place waste in an appropriate container frequently and at regular intervals.
- g) Wet and carefully roll drop sheets toward the centre of the work area. Remove visible dust and debris by wet wiping and/or using a vacuum equipped with a HEPA filter.
- h) Place drop sheets in an appropriate waste container.
- i) Inspect work area for cleanliness. Deficiencies shall be corrected when they are identified.
- j) Complete rinsing with clean water.
- k) Avoid re-contamination of clean areas.
- l) Clean all tools, supplies and equipment in the work area by wet wiping and/or using a vacuum equipment with a HEPA filter. Equipment that cannot be readily cleaned (e.g. vacuum hose, wire brushes, etc.) shall be cleaned to the extent that is practical and placed in sealed containers before removing from the work area.
- m) Waste containers shall be thoroughly cleaned on the exterior and sealed prior to leaving the work area.
- n) Conduct clearance testing if required.
- o) Following a successful visual inspection, and clearance testing if required, a sealant or an encapsulant may be applied.

11.2 Class 2 Operations

- a) Cleaning shall be completed in a top-to-bottom methodology (i.e. start in high locations and clean down towards floor level) and beginning at the farthest point of the work area from the entrance (i.e. clean towards the entrance to the work area).
- b) Compressed air or dry sweeping shall not be used to clean the work area.
- c) The use of lead-specific cleaning solutions may be required as part of the cleaning process.

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- d) Clean all surfaces in the work area by wet wiping and/or using a vacuum equipped with a HEPA filter.
- e) When using wet wipe cleaning, frequently and at regular intervals,
 - i. Use folding technique to expose a clean surface of the cloth.
 - ii. Rinse cloth with clean water.
 - iii. Replace soiled cloth with clean cloth.
 - iv. Replace dirty water with clean water.
- f) Clean and rinse a small area at a time before proceeding to the next area.
- g) Place waste in an appropriate container frequently and at regular intervals.
- h) Wet and carefully roll drop sheets toward the centre of the work area. Remove visible dust and debris by wet wiping and/or using a vacuum equipped with a HEPA filter.
- i) Place drop sheets in an appropriate waste container.
- j) Inspect work area for cleanliness. Deficiencies shall be corrected when they are identified.
- k) Complete rinsing with clean water.
- l) Avoid re-contamination of clean areas.
- m) Clean all tools, supplies and equipment in the work area by wet wiping and/or using a vacuum equipment with a HEPA filter. Equipment that cannot be readily cleaned (e.g. vacuum hose, wire brushes, etc.) shall be cleaned to the extent that is practical and placed in sealed containers before removing from the work area.
- n) Waste containers shall be thoroughly cleaned on the exterior and sealed prior to leaving the work area.
- o) Conduct clearance testing if required.
- p) Following a successful visual inspection, and clearance testing if required, a sealant or an encapsulant may be applied.

11.3 Class 3 Operations

- a) Cleaning shall be completed in a top-to-bottom methodology (i.e. start in high locations and clean down towards floor level) and beginning at the farthest point of the work area from the entrance (i.e. clean towards the entrance to the work area).
- b) Compressed air or dry sweeping shall not be used to clean the work area.

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- c) The use of lead-specific cleaning solutions may be required as part of the cleaning process.
- d) Clean all surfaces in the work area by wet wiping and/or using a vacuum equipped with a HEPA filter.
- e) When using wet wipe cleaning, frequently and at regular intervals,
 - i. Use folding technique to expose a clean surface of the cloth.
 - ii. Rinse cloth with clean water.
 - iii. Replace soiled cloth with clean cloth.
 - iv. Replace dirty water with clean water.
- f) Clean and rinse a small area at a time before proceeding to the next area.
- g) Place waste in an appropriate container frequently and at regular intervals.
- h) Wet and carefully roll drop sheets toward the centre of the work area. Remove visible dust and debris by wet wiping and/or using a vacuum equipped with a HEPA filter.
- i) Place drop sheets in an appropriate waste container.
- j) Inspect work area for cleanliness. Deficiencies shall be corrected when they are identified.
- k) Complete rinsing with clean water.
- l) Avoid re-contamination of clean areas.
- m) Clean all tools, supplies and equipment in the work area by wet wiping and/or using a vacuum equipment with a HEPA filter. Equipment that cannot be readily cleaned (e.g. vacuum hose, wire brushes, etc.) shall be cleaned to the extent that is practical and placed in sealed containers before removing from the work area.
- n) Waste containers shall be thoroughly cleaned on the exterior and sealed prior to leaving the work area.
- o) When HEPA Filtered Exhaust Fan (negative air units) are used, cleaning shall start at the farthest locations from the negative air units (i.e. cleaning shall be completed moving towards negative air units).
- p) Cleaning shall include the worker decontamination chambers and waste transfer rooms.
- q) Minimize water pooling within the work area.
- r) Leave the work area and surrounding areas dry and visibly free of dust and debris for visual inspection by the project authority.

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- s) Conduct clearance testing if required.
- t) Following a successful visual inspection, and clearance testing if required, a sealant or an encapsulant may be applied.

11.3.1 Work Area Tear Down

- a) Inspect the work area prior to starting tear down. Ensure the work area has achieved the appropriate level of cleanliness, that clearance sample requirements have been met, and that clearance has been accepted by the project authority.
- b) Remove polyethylene sheeting used during abatement by wetting and carefully rolling towards the centre of the work area. Remove visible dust and debris by wet wiping and/or using a vacuum equipped with a HEPA filter.
- c) Immediately upon shutting down negative air units, seal air inlet grill and exhaust vent with polyethylene and tape. Clean the cabinet by wet wiping before removal from the work area.
- d) Following enclosure dismantling, a post tear down visual inspection should be completed. If required, additional cleaning should be completed by wet wiping and/or using a vacuum equipped with a HEPA filter.

12. LEAD CLEARANCE STANDARDS

12.1 Lead Clearance Assessments

12.1.1 Class 1 and Class 2 Operations

A lead clearance assessment shall be conducted upon the completion of Class 1 and 2 Operations and shall consist of a visual assessment. The area shall pass the inspection if it is visually clean. Special consideration shall be given to areas that are difficult to access, or clean, such as corners or rough surfaces.

Lead clearance wipe sampling may be considered for large scale Operations conducted in areas of buildings occupied by sensitive populations including:

- a) Children (e.g. daycares and primary schools).
- b) Pregnant and nursing women.
- c) Food preparation, processing and serving areas.
- d) Pediatrics, labour and delivery, and maternity areas of hospitals.
- e) Residential buildings.

12.1.2 Class 3 Operations

Lead clearance testing shall be conducted upon the completion of Class 3 Operations. The purpose of clearance testing is to verify that work areas have been

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cleaned sufficiently and to demonstrate that it is safe for workers and occupants.
The clearance assessment and testing must be completed by a competent person.

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The clearance assessment has two components:

1. A visual assessment

The work area passes the visual inspection if it is adequately cleaned of dust and debris. Special consideration shall be given to areas that are difficult to access or clean such as corners or rough surfaces. The presence of dust, debris or residue indicates that the cleaning was insufficient and additional cleaning shall be completed. Following additional cleaning, a follow-up inspection is required.

2. Collection and analysis of wipe samples

Wipe sampling shall not be completed until the area passes visual inspection. Wipe samples shall be collected in accordance with a validated analytical method. Wipe samples may not be required if a physical barrier will be installed over cleaned surfaces in a manner that prevents access (to the cleaned surfaces) by building occupants.

12.2 Clearance Wipe Sampling

Clearance wipe sampling provides analytical confirmation that an area has been adequately cleaned. Representative sample locations and sample quantities must be collected from the project area in order to effectively demonstrate that the lead concentration is within acceptable levels. Samples shall be collected in accordance with the procedures in Section 13. The following table lists the minimum number of clearance wipe samples to be collected.

Table 4: Minimum Number of Clearance Wipe Samples

Area of Work or Cleaned Surface(s)	Minimum Number of Wipe Samples
1 square meter or less	1
Greater than 1 square meter but less than 10 square meters	2
Greater than 10 square meter but less than 100 square meters	3
Every additional 100 square meters	1
If present, inside the clean room entrance/exit to the work area	1
Clearance for Indoor Firing Ranges	
Exhaust fan inlet area and outlet area (1 sample in each area)	2
Range floor	3
Horizontal surfaces other than the floor (i.e. counters, sills)	3
Bullet trap area	3
Vertical surfaces such as walls, frames	3
Horizontal surfaces exterior to range (i.e. at entrances)	3

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If present, inside the clean room entrance/exit to the work area	1

A minimum of 1 field blank shall be collected for each clearance sampling event. No less than 1 field blank for every 10 field samples, or part thereof, shall be submitted for laboratory analysis.

12.2.1 Wipe Sampling Clearance Criteria

Lead concentrations of clearance wipe samples, when at or below the assigned clearance criteria, provides analytical confirmation that an area has been adequately cleaned.

Wipe sampling clearance criteria, as detailed in Table 5, are not intended to be an action level or trigger to initiate cleanup activities.

Table 5: Wipe Sampling Clearance Criteria

Area or Surface to be Tested	Clearance Criteria ³	
	µg/100 cm ²	µg/ft ²
Exterior concrete and rough surfaces	86.1	800
Interior concrete, window troughs, rough surfaces	43	400
Interior window sills	26.9	250
Firing ranges and work places where lead is used	21.5	200
Floors and other surfaces: Non-Residential	21.5	200
Floors and other surfaces: Residential	4.3	40
Child care facilities, primary schools, food preparation, food processing, pediatrics, labour and delivery, and maternity areas of hospitals (all surfaces routinely accessible by occupants or used in food processing).	4.3	40

12.3 Air Sampling for Lead Clearance

Surface wipe sampling is the preferred clearance testing method over air sampling as it more accurately represents the remaining lead and the potential for future worker or occupant exposure. Air sampling should not be used alone for clearance purposes, but can be considered to supplement clearance wipe sampling.

12.4 Composite Wipe Sampling

Composite wipes are wipe samples consisting of more than one co-mingled wipe per container. Composite samples provide an average level of lead over the

³ If these levels cannot be achieved, a barrier (e.g., drywall, paint or surface coating, tile) may be installed to prevent access to the cleaned surface by building occupants.

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multiple samples and, therefore, low levels in some samples may mask higher levels (that exceed clearance standards) in others.

There is a lack of inter-laboratory proficiency testing programs for analysis of composited wipe samples that may place the validity of the data under scrutiny. Due to accreditation reporting requirements most laboratories will be obligated to place significant disclaimers and limitations on the results of composite wipes which may further confound interpretation and call into question the value of the results.

If a composite sample is analyzed and exceeds the clearance criteria, all areas encompassed by that composite sample must be re-cleaned (possibly multiple rooms or a large area). Alternatively, if a discrete sample is collected in each room/area, only the room/area associated with a sample that exceeds the criteria will require re-cleaning.

If a competent person determines that composite wipe sampling is appropriate for clearance or pre-abatement assessment of lead, then the following recommendations, in addition to general wipe sample requirements and quality assurance and quality control measures, should be observed:

- a) Confirm that the laboratory is accredited to perform lead analysis and can analyze composite samples and, if so, whether special quality assurance practices are required.
- b) Wipes used for composite samples shall meet the requirements of a validated analytical method.
- c) Composite samples must not contain subsamples from different component or surface types. All the subsamples must be collected from same building components and surface type (e.g. a single composite sample shall not be collected from a carpeted floor and a concrete floor).
- d) The same type of wipe must be used for all subsamples of a composite sample.
- e) The surface areas of subsamples used in a composite sample must swab the same surface area. For example, each subsample in a single composite sample would wipe 100 square centimeters.
- f) The areas to be sampled and composited shall be determined prior to the start of sampling.
- g) A new wipe must be used for each area sampled. No more than four subsamples shall make up a composite sample.
- h) All subsamples must be inserted into the same container.
- i) Composite samples must not be taken from rooms/areas that have dramatically different conditions.

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- j) Laboratory-supplied containers must be used to contain wipe samples to facilitate quantitative rinsing.

The clearance level criterion must be adjusted relative to the number of subsamples in the composite sample. This is done by dividing the clearance level by half the number of subsamples in the composite.

Example: A composite wipe sample contains four (4) subsample wipes. The applicable clearance level for the surface sampled is $40\mu\text{g}/\text{ft}^2$. Divide $40\mu\text{g}/\text{ft}^2$ by 2 (which is half of the 4 subsamples). The adjusted clearance level is $20\mu\text{g}/\text{ft}^2$. All samples must meet the adjusted clearance level to be considered a pass.

The total number of required samples shall meet the requirements of Table 4 (i.e. where two samples are required in the table, either two discrete samples or two composite samples are required).

13. LEAD SAMPLING ANALYTICAL METHODOLOGY

Prior to sample collection, an accredited laboratory and validated analytical method shall be selected for the sample analysis. Samples shall be collected by a competent person in accordance with the validated method.

13.1 Laboratory Accreditations

Ensure laboratories are accredited to perform the analysis requested. The following accrediting agencies are recommended as accrediting bodies for the National Lead Laboratory Accreditation Program (NLLAP):

- Canadian Agency for Laboratory Accreditation (CALA)
- American Industrial Hygiene Association (AIHA)
- American Association for Laboratory Accreditation (A2LA)
- Perry Johnson Laboratory Accreditation, Inc. (PJLA)
- ANSI-ASQ National Accreditation Board/ACLASS
- Laboratory Accreditation Bureau

13.2 Analytical Methods and Limits of Detection

The following table is a summary of analytical methods, applicable to a specific sample matrix (i.e. paint chips, solids, dust wipes, air), and the corresponding limit of detection for each method. An accredited laboratory should be consulted if additional information or clarification is required.

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Table 6: Analytical Methods and Corresponding Limits of Detection

Method	Matrix	Limit of Detection (LOD)	Weight/Area/ Volume required for the LOD
Flame Atomic Absorption Spectrometry			
SW846-7000B	Paint Chips	100 mg/Kg (0.010% wt.)	0.2 g
	Solids	40 mg/Kg (0.004% wt.)	0.5 g
	Dust (wipes)	10 µg/ft ²	144 in ²
NIOSH 7082	Air	0.004 mg/m ³	1000 L
Inductively Coupled Plasma Atomic Emission Spectrometry			
SW846-6010B/C	Solids	1 mg/Kg (0.0001% wt.)	0.5g
	Dust (wipes)	0.5 µg/ft ²	144 in ²
NIOSH 7300 modified	Air	0.0005 mg/m ³	1000 L
Graphite Furnace Atomic Absorption Spectrometry			
SW846-7010	Solids	0.3 mg/Kg (0.00003% wt.)	0.5 g
	Dust (wipes)	0.075 µg/ft ²	144 in ²
NIOSH 7105	Air	0.00003 mg/m ³	1000 L

13.3 Sample Collection

13.3.1 Air Sampling / Air Monitoring

Air monitoring may be necessary to:

- a) Ensure work operations are not producing airborne concentrations of lead which exceed the Time-Weighted Average (TWA) or the protection factor for the respirators being used.
- b) Ensure that workers or occupants in areas adjacent to the work area are not being exposed to airborne lead at concentrations exceeding the TWA.

Air monitoring may be performed inside or outside of the Work Area. If airborne lead levels in the Work Area exceed the Maximum Use Concentration specified for the assigned respirator, work procedures shall be reviewed and altered to reduce airborne lead levels or determine if alternate respiratory protection is required.

If airborne lead is detected at concentrations exceeding the TWA in occupied areas adjacent to the Work Area, an evaluation to determine the cause shall be conducted and an adequate means to control the exposure implemented.

Air sampling collection should be completed following approved analytical methods.

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13.3.2 Paint and Surface Coating Bulk Sampling

Collect samples of distinctive paint finishes and surface coatings, present in more than an insignificant application, where removal of the paint is possible. Collect samples by scraping the paint or surface coating to include all layers.

The following is designed for use as a reference. Samples shall be collected in accordance with the requirements of the analytical method selected and in consultation with the analytical laboratory.

Required Equipment

- a) Appropriate, sealable sample container – one per sample.
- b) Sampling tool (e.g. scraper, knife).
- c) Disposable Gloves.
- d) Indelible Marker.
- e) Chain of Custody Form.

Sampling Procedure

- a) Don clean disposable gloves in preparation for sample collection.
- b) Select discreet area for sample collection.
- c) Remove all layers of paint (to substrate), place into a sample container and seal the sample container.
- d) Using indelible marker, label the container with a unique sample number identifier.
- e) Clean up sampling area by wet wiping or using a vacuum equipped with a HEPA filter.
- f) Encapsulate or repair damaged area, as appropriate.
- g) Complete the Chain of Custody form and submit to an accredited laboratory.

13.3.3 Wipe Sampling

Wipe sample collection should follow NIOSH method 9100 “Lead in Surface Wipe Samples” or NIOSH method 9102 “Elements on Wipes”.

13.4 Sampling Using Portable X-Ray Fluorescence (XRF) Analyzer

The U.S. Environmental Protection Agency (EPA) and U.S. Department of Housing and Urban Development (HUD) historically stated that concentrations of lead in paints and surface coatings of one milligram per square centimetre (mg/cm²) were comparable to 0.5% and were considered “elevated” for lead.

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In cases when laboratory analysis is impractical, or when virtually immediate results are required, a hand-held portable X-Ray Fluorescence Analyzer (XRF) may prove useful. An XRF can provide fast, non-destructive, on-site, analysis of lead concentration in paints and surface coatings, soil, air and surface dust.

13.4.1 Paint and Surface Coating Sampling by XRF

It is of critical importance to understand the Limit of Detection (LOD) of an XRF analyzer. Although the accuracy of XRF analyzers has improved in recent years, the LOD for portable XRF analyzers varies depending on the model used. An XRF can readily determine what paints and surface coatings contain elevated lead above $1\text{mg}/\text{cm}^2$ (comparable to 0.5 % lead by weight), however, may not be able to determine if lead concentrations are below the de minimis level (i.e. 0.1%). Portable XRF analyzers may be used as a screening tool to confirm if paints and surface coatings are considered to be lead-based (i.e. lead concentration of $1\text{mg}/\text{cm}^2$ or greater). Physical samples of paints or surface coatings with readings below $1\text{mg}/\text{cm}^2$ should be collected for laboratory analysis to confirm lead content.

13.4.2 Air Sample and Dust Wipe Sample Analysis by XRF

An XRF analyzer can quickly determine the composition of elemental lead collected on an air filter cassette and dust wipe sample. This can be beneficial for worker exposure monitoring, providing instructions to workers regarding cleaning methods, evaluating the efficacy of engineering controls and hygiene practices and to perform clearance sample analysis. It is important to realize that the use of portable direct-read instrumentation is not necessarily directly comparable to laboratory analytical methods. Consideration should be given to using portable direct-read instruments in conjunction with laboratory analysis.

To properly obtain and analyze air samples by XRF, samples must be collected and analyzed in accordance with U.S. National Institute of Occupational Safety and Health (NIOSH) Manual of Analytical Methods, Fourth Edition, Method 7702, Issue 1 Lead By Field Portable XRF (January 15, 1998).

APPENDIX I

LIST OF LEGISLATION, GUIDELINES AND RELEVANT DOCUMENTS

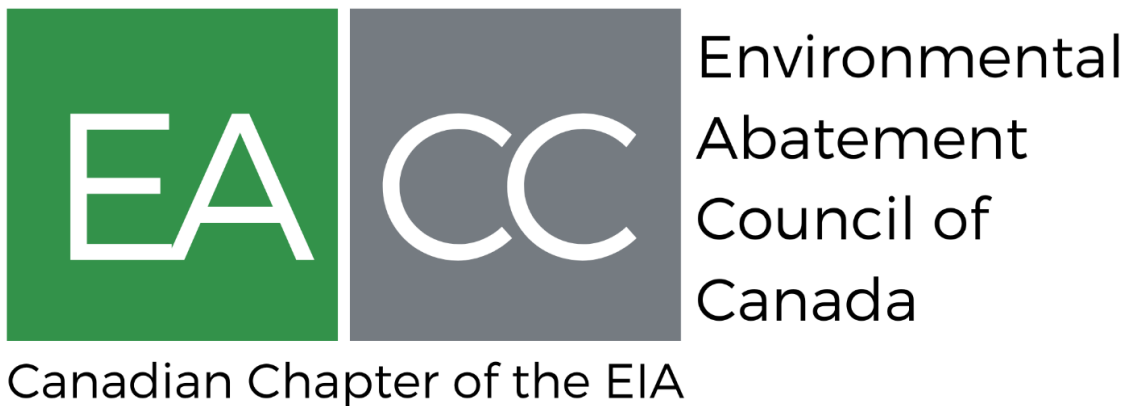
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- Ontario Ministry of Labour. (2011, April). *Lead on Construction Projects*.
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- Service Ontario. (2013, January 1). *Occupational Health and Safety Act, ONTARIO REGULATION 490/09 DESIGNATED SUBSTANCES*.
- U.S. Department of Health and Human Services: Public Health Service: Agency for Toxic Substances and Disease Registry. (2007, August). *Toxicological Profile for Lead*.
- U.S. Department of Housing and Urban Development. (2012, July). *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing; Office of Healthy Homes and Lead Hazard Control Second Edition, July 2012*.
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- United States of America Department of the Navy; Bureau of Medicine and Surgery. (2002, May). *Indoor Firing Ranges Industrial Hygiene Technical Guide*.
- Worksafe B.C. (2011). *Lead-Containing Paints and Coatings, Preventing Exposure in the Construction Industry*.

APPENDIX II DEFINITIONS	
Term	Definition
Action Level	Concentration of ½ of the Occupation Exposure Limit (OEL) for an airborne contaminant at which precautions are implemented to be protective of worker health.
Clearance Tests	Samples collected and analyzed following abatement to verify an acceptable level of cleanliness.
Competent Person or Supervisor	As defined under the Ontario Occupational Health and Safety Act.
Contaminated Area	The portion of the Project where active disturbance, handling or cleanup of lead is occurring.
Designated Substance	As defined in Ontario Regulation 490/09 under the Ontario Occupational Health and Safety Act.
Dust Suppression	Measures taken to reduce the release of dust during work.
Fit-test	A qualitative or quantitative method to evaluate the efficiency of a specific make, model and size of respirator on an individual.
HEPA Filter	High Efficiency Particulate Air filter capable of capturing and retaining particles greater than or equal to 0.3 micrometers in diameter, at a minimum efficiency of 99.97%.
Lead	A malleable metal that can cause acute and chronic health effects in humans. Lead is an additive and contaminant in many frequently used building materials.
Lead-Containing Material (LCM)	Building materials comprising of lead or which contain lead. Examples are provided in Section 3.2.
Low-level lead paints and surface coatings	Paint or surface coating containing less than or equal to 0.1% lead by dry weight (1000 µg/g, mg/kg, ppm).
Lead-containing paints and surface coatings	Paint or surface coating containing greater than 0.1% lead by dry weight, (1000 µg/g, mg/kg, ppm) and less than 0.5% lead by dry weight (5000 µg/g, mg/kg, ppm).
Lead-Based Paints and Surface Coatings	Paint or surface coating containing equal to or greater than 0.5% lead by dry weight (5000 µg/g, mg/kg, ppm).
MSDS	Material Safety Data Sheet, required by Workplace Hazardous Materials Information System (WHMIS) legislation, and giving information on hazardous materials, including properties, hazards, first-aid, emergency response, and personal protection.
NIOSH	National Institute for Occupational Safety and Health
Polyethylene Sheeting	Plastic sheeting installed with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required, to provide a continuous membrane to protect underlying surfaces from damage and to prevent escape of airborne contamination into occupied areas.
Respirator	An apparatus worn over the mouth and nose or the entire face to prevent the inhalation of dust, mist, fume, vapours or other noxious substances.
Wetting Agent	A chemical substance, also called surfactant, that increases the spreading and penetrating properties of a liquid by lowering its surface tension. 235 millilitres (1 cup) of detergent to 20 litres of water.

EACC

Lead Guideline

For Construction, Renovation, Maintenance or Repair



70 Leek Crescent
Richmond Hill ON, L4B 1H1
(416) 499-4000
www.eaccanada.ca

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 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 K1A 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

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 the cost of additional review and correction.
- .3 If such Work is found in accordance with Contract Documents, The owner will pay the cost of review and replacement.

1.5. INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection and Testing Agencies will be engaged by Contractor for the 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 the full degree of defect. Correct defects and irregularities as advised by the Consultant at no cost to the 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 the 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 the 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 & BACKFILL

- .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 the 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 than three site visits.
- .2 Test within 16 hours from time called to do so by the 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 the Paving Contractor. At completion of the paving project, inform the 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 the 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 the 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 a thermographic scan of the 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 the 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 the 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

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 the Consultant's approval.
- .3 Salvage and assist in recycling products for potential reuse wherever possible.
- .4 Remove temporary facilities from the site when directed by the Consultant.

1.3. DEWATERING

- .1 Provide temporary drainage and pumping facilities to keep excavations and the site free from standing water. Provide necessary pumps (including spare pumps) and temporary drainage for keeping the Work free of water throughout the 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 the 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 a safe working environment.
- .4 Maintain temperatures of minimum:
 - .1 10 degrees C in areas where construction is in progress, until takeover by the 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 the atmosphere of occupied areas.

- .3 Dispose of exhaust materials in a 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 the 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 the 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 the 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 the 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 a 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 the 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 the 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 email access and a printer on site.

END OF 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 the site when directed by the 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 1 inch 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 the 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 stairwells, 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 the 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 the 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 the 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 the 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 the site and contents of the 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 the 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 the open. Locate stored materials and equipment to facilitate prompt inspection.
- .3 Store packaged materials and equipment undamaged, in their original wrappings or containers, with manufacturer'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 the 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 the 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

01 54 00 – Materials and Equipment

1.0 GENERAL

1.1. RELATED SECTIONS

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

1.2. PRODUCT AND MATERIAL QUALITY

- .1 Products, materials, equipment and articles referred to as “Products”; throughout the specifications incorporated in the Work, shall be new, not damaged or defective, and of the best quality, compatible with specifications for the purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Defective products will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace defective products at own expense, and be responsible for delays and expenses caused by rejections.
- .3 Should any dispute arise as to the quality or fitness of products, the decision rests strictly with the Board contact, based upon requirements of the Contract Documents.
- .4 Current Material Safety Data Sheets shall be on file with the successful Contractor and shall be provided to the Board contact upon request, within twenty-four (24) hours.
- .5 Material safety data sheets are not required for products currently WHMIS exempt.

1.3. EQUIPMENT/TOOL MATERIALS STORAGE, HANDLING, AND PROTECTION

- .1 Handle and store products in a manner to prevent damage, adulterations, deterioration, and soiling, and in accordance with manufacturer's instructions.
- .2 Store packaged or bundled products in original and undamaged condition, with manufacturer's seals and labels intact.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Provide and maintain tools, equipment and materials in a clean and orderly condition. Board tools, ladders, lifts, power cords, flashlights etc. are not to be used.

- .5 Materials are to be stored in a manner to cause the least interference with Work activities.
- .6 The Contractor shall determine with the Board contact, prior to ordering materials, those locations that are suitable for receiving and storage of materials and equipment.
- .7 All materials and equipment shall be kept in a secure area, at Contractor's expense, or removed from the job site when Work is not actually in progress.
- .8 Vehicles, trailers or other similar apparatus may not be stored or parked overnight at site without written authorization from Board contact. Written requests are to be forwarded directly to the Board contact.
- .9 Approval for parking does not imply any liability or responsibility for safe keeping by the Board.
- .10 The Contractor may use the existing electrical and water services, as required, for the Work, and the costs of these services shall be borne by the Board.

1.4. WORKMANSHIP

- .1 Workmanship shall be the best quality, executed by Workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Consultant if required Work is such as to make it impractical to produce required results.
- .2 Do not employ any unfit persons or anyone unskilled in their required duties.
- .3 Decisions as to the quality or fitness of Workmanship in cases of dispute rest solely with the Board contact, whose decision is final.
- .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.
- .5 The Contractor shall make their own arrangements for emergency treatment of accidents.
- .6 Any accidents shall be reported immediately to the Board contact.
- .7 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 Subcontractors.
- .8 The Contractor shall supply constant on-site supervision in the form of a Project Superintendent. The Project Superintendent shall have within their authority to negotiate minor changes regarding scheduling, manpower and equipment.

1.5. MANUFACTURER'S INSTRUCTIONS

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

1.6. TOOLS OF THE TRADE

- .1 The Board will not pay the Awarded Bidder a fee for tools and equipment that are considered "tools of the trade" that are required to perform the work in this Tender or any change orders.

1.7. EXISTING EQUIPMENT

- .1 Contractor shall demolish and dispose of all existing equipment specified to be removed and or replaced including obsolete services not being reused. The Board shall have first rights of refusal on all demolished equipment and or parts and the Contractor shall provide a minimum of (5) working days notice prior to disposal of the equipment, parts, or equipment and set aside same in a suitable location to be recovered by Board technicians.

END OF 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 the 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 the building.

1.4. AVAILABILITY

- .1 Immediately upon receipt of the Board's Purchase Order, review Product delivery requirements and anticipate foreseeable supply delays for any items.

- .2 Immediately upon receipt of the Board's 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 Subcontractors shall identify in writing any delivery issues within 14 days of receiving the Contractor's 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 the 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 the 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 disturbance to the owner.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in a 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 reinstallation 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 the Consultant if there is interference. Install as directed by the 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 the Consultant.

END OF 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 practice 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 the 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 the 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 benchmarks 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 the 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 the area of Work and notify the Consultant of findings.
- .2 Remove abandoned service lines running through existing and new structures. Cap or seal lines at cut-off points as directed by the 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

SECTION 01 73 30 – EXECUTION AND CUTTING AND PATCHING

1.0 GENERAL

1.1. RELATED SECTIONS

- .4 Section 01 32 00 - Construction Progress Documentation: Submittals and scheduling.
- .5 Section 01 61 00 - Product Requirements.
- .6 Section 01 70 00 – Examination and Preparation
- .7 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.

1.2. SUBMITTALS

- .8 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.
- .9 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.

1.3. TOLERANCES

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

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

2.0 PRODUCTS

2.1. MATERIALS

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

3.0 EXECUTION

3.1. 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.

3.2. PREPARATION

- .1 Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of the Project from damage.
- .2 Provide protection from elements for areas which may be exposed by uncovering work.
- .3 Maintain excavations free of water.

3.3. 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 a masonry saw or core drill. Pneumatic tools are 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 the 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 the party responsible thereof.
- .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.

3.4. 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 the nearest intersection or natural break. For an assembly, refinish the 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 a distance of 1.5m under normal lighting.

END OF 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 them from premises at the 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 a waste container at the end of each working day.
- .3 Vacuum clean interior areas prior to the 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 the 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 the 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 affected by construction final exterior cleaning operations shall be performed by the General Contractor or competent Subcontractor. Contractor's "broom cleaning" only is not acceptable.
- .2 Final exterior cleaning shall include:
 - .1 broom clean and wash exterior walkways, 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

01 78 10 – Closeout Submittals and Requirements

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 78 10 – WRDSB Warranty Card, Appendix 00 41 13A

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 the 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 them to the Consultant for review.
- .2 Copy will be returned to the contractor with the Consultant's comments.

- .3 Revise content of documents as required prior to final submission.
- .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 numbers for such subcontractors as Plumbing, Electrical, Sprinklers, Fire System, Heating, etc.
 - .2 Specified warranties for contractor, each subcontractor and supplier.
 - .3 WRDSB Project Asset and Warranty Card, Appendix 00 41 13A
 - .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 a copy of the 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 a 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 the 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 the 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 the contractor with the Consultant's comments.
- .4 Revise content of documents as required prior to final submission.
- .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 the 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 a signed receipt from the Owner's Representative for delivered materials and include a 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 the 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 Listsubcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Except for items put into use with Owner's permission, leave the 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

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 a 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 the 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 the 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 the 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 the 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 subcontractors 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 the satisfaction of the Consultant.

END OF 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 a 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 a 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 a 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 the 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

PART 1 - GENERAL

1.1 Summary

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

1.2 Administrative Requirements

- .1 Pre-demolition meeting:
 - .1 Review existing conditions at the *Place of the Work* thoroughly to establish full extent of items to be removed and items to remain. Commencement of demolition work will be considered to be acceptance of existing conditions at the *Place of the Work* and removal of such items.
 - .2 Examine adjacent properties to determine extent of protection required.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .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.
 - .2 Comply with Section 01 32 00.
 - .3 Submit existing conditions documentation before demolition work begins.
 - .2 Inventory of items to be salvaged:
 - .1 Prepare typed inventory of units to be salvaged and cross-reference to drawing showing existing elevations.
 - .2 Submit inventory following procedures for submittal of *Shop Drawings* in accordance with Section 01 33 00.

Demolition

1.4 Quality Assurance

.1 Qualifications:

.1 Subcontractor:

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

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that utilities have been disconnected and capped.
- .2 Observe existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- .3 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- .4 When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to *Consultant*.
- .5 Survey of existing conditions: Record existing conditions by use of photographs in accordance with Section 01 32 00.

3.2 Utility Services and Mechanical / Electrical Systems

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

3.3 Selective Demolition, General

- .1 Demolish and remove existing construction only to the extent required by new construction, and as otherwise indicated. Use methods required to complete the work within limitations of governing regulations and as follows:
 - .1 Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - .2 Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - .3 Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

Demolition

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

3.4 Selective Demolition Procedures for Specific Materials

- .1 Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.5 Salvage

- .1 Remove and store items indicated or directed for salvage. Remove, handle and transport such items to storage area designated in the *Contract Documents*, 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 The *Owner* shall review *Place of the Work* prior to commencement of demolition and instruct the *Contractor* of the items to be retained for re-use or be turned over to the *Owner*.
- .3 Remove and store indicated items for future use by *Owner*. Remove, handle and transport such items to storage area indicated in the *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.

3.6 Protection

- .1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades and parts of existing building to remain. Make good damage caused by demolition.
- .2 Take precautions to support affected structures and, if safety of building being demolished or adjacent structures or services appears to be endangered, cease operations and notify demolition engineer, *Contractor* and *Consultant*.
- .3 Provide temporary weather enclosures in accordance with Section 01 53 00.
- .4 Prevent debris from obstructing active services and drainage systems.

Demolition

- .5 Protect work to remain against damage. Repair or replace damaged work at no additional cost to the *Owner*.

END OF SECTION

Rough Carpentry

PART 1 - GENERAL

1.1 Summary

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

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Shop drawings:
 - .1 Clearly indicate details of construction, profiles, jointing, fastening and other related details.
- .3 Compliance certification; pressure treated lumber and plywood:
 - .1 Submit certificates from wood treatment facility indicating compliance with specified standards, processes employed during treatment, and retention treatment values.

1.3 Product Handling

- .1 Product handling shall be in accordance with Section 01 61 00 as supplemented by the requirements of Section 06 10 53.
- .2 Where stability of wood dimensions and tolerances is required to ensure accurate installation of later work, store and install only in dry areas where no installation of moist or wet materials will be undertaken.

PART 2 - PRODUCTS

2.1 Wood Materials

- .1 General requirements:
 - .1 Except as indicated or specified otherwise lumber shall be softwood, S4S, moisture content not greater than 19% at time of installation, in accordance with following standards:
 - .1 CSA O141-05.
 - .2 NLGA-2017 Standard Grading Rules for Canadian Lumber.
- .2 Furring, blocking, nailing strips, grounds:
 - .1 Use S2S material.
 - .2 Dimension lumber sizes: in compliance with Section 12 of the NLGA-2017.
 - .3 Dimension lumber species and grades:
 - .1 Spruce-Pine-Fir.
 - .2 Light framing in accordance with NLGA-2017 Construction grade, S-Dry.
 - .3 Planks in accordance with NLGA-2017 No. 2 grade, S-Dry.

Rough Carpentry

- .4 Boards in accordance with NLGA-2017 No. 4 Common grade, S-Dry.

2.2 Wood Treatment

- .1 Fire retardant pressure treatment:
- .1 Wood shall be pressure impregnated with fire-retardant chemicals in accordance with CAN/CSA O80 Series-15 and have flame-spread rating of not more than 25 in accordance with CAN/ULC-S102-10.

2.3 Panel Materials

- .1 Softwood plywood (CSP): in accordance with CSA O151-17.
- .2 Douglas Fir plywood (DFP): in accordance with CSA O121-17.

2.4 Fastenings and Hardware

- .1 General:
- .1 Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 38 mm (1-1/2") into wood substrate.
- .2 Anchors to concrete and unit masonry: Capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488/E488M-22.
- .3 Use surface fastenings of following types, except where specific type is indicated.
- .1 To hollow masonry, plaster and panel surfaces use 9 mm (11/32") expansion bolts or other acceptable anchor.
- .2 To solid masonry and concrete use expansion bolts.
- .3 To structural steel use bolts through drilled hole, or welded stud-bolts or power driven self-drilling screws, or welded stud-bolts.
- .4 To steel deck use bolts through drilled hole or power driven self-drilling screws.
- .4 Fastener materials:
- .1 Hot-dip galvanized fasteners: in accordance with ASTM A153/A153M-16a Class A or B1 G185 and connectors meeting ASTM A653/A653M-18 Class G-185 sheet or better.
- .5 Hardware materials:
- .1 Hot-dipped galvanized in accordance with ASTM A153/A153M-16a, Class A or B1, and connectors in accordance with ASTM A653/A653M-18, Class G185.

2.5 Source Quality Control

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

Rough Carpentry

PART 3 - EXECUTION

3.1 General

- .1 Layout work to accommodate work of others. Cut and fit accurately. Erect in position indicated. Align, level, square, plumb, and secure work permanently in place.
- .2 Bore holes true to line and to same size as bolts. Drive bolts into place for snug fit, and use plates or washers for bolt head and nut bearings. Turn up bolts and lag screws tightly when installed, and again just before concealed by other work or at completion of work.
- .3 Include in work of this section rough hardware such as nails, bolts, nuts, washers, screws, clips, and connectors required for complete and proper installations; and operating hardware required on work of this section for temporary use.
- .4 Do not attach work by wood plugs or blocking in concrete or masonry.
- .5 Do not regard nailers, blocking, and such other fastening provision indicated as exact or complete. Install required provisions for fastening, located and secured to suit *Place of the Work* conditions, and adequate for intended support.
- .6 Verify that grounds required for fastening of components and equipment are located correctly, and sized for adequate support.
- .7 Do not rip or mill fire retardant treated lumber. Only end cuts, drilling holes, and joining cuts are permitted.

3.2 Miscellaneous Plywood Blocking

- .1 Provide minimum 19 mm (3/4") softwood plywood blocking for attachment of miscellaneous fitments as indicated.
- .2 Wood blocking within gypsum board metal stud assemblies under work of Section 09 22 00.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Work of this section includes architectural woodwork as set-out in the Millwork Material Legend, and as indicated on drawings, including, but not limited to, the following:
 - .1 Cabinetry and hardware.
 - .2 Plastic laminate fabrications.
 - .3 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.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data for each type of *Product* and process proposed for use in the work of this section and incorporated into items of architectural woodwork.
- .3 Shop drawings:
 - .1 Shop drawings for the following shall be engineered shop drawings:
 - .1 Wall hung or suspended millwork.
 - .2 Submit shop drawings for the work of this section complying with the North American Architectural Woodwork Standards 4.0 requirements.
 - .3 Indicate quality standards and grades.
 - .4 Include full scale drawings of exposed-to-view edge conditions.

Architectural Woodwork

- .5 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.
- .6 Include materials and their characteristics and finishes as applicable including the following:
 - .1 Panel core and material types, thicknesses, compliance with specified standards, special treatments.
 - .2 Adhesive types to be used and locations.
 - .3 Finishing requirements including North American Architectural Woodwork Standards 4.0 finish system number, sheen, and required application steps.
- .7 Submit coordination drawings indicating locations of concealed grounds, cut-outs, plates, and other required fabrications.
- .8 Show relation to adjoining construction, details of outside and inside corners and door openings.
- .4 Selection samples:
 - .1 Casework hardware, one unit of each type and finish.
- .5 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 Submit closeout submittals.
- .2 Operation and maintenance data:
 - .1 Submit maintenance and cleaning instructions for finishes requiring specific care, noting particularly those procedures or materials which will cause damage to finished surfaces to be included in maintenance manuals.
- .3 Maintenance materials:
 - .1 Deliver extra sets of hardware items for maintenance as follows:
 - .1 2 % of each type actually installed, but not less than 2 sets.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:

Architectural Woodwork

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

- .1 Product handling shall be in accordance with Section 01 61 00 as supplemented by the requirements of Section 06 40 00.
- .2 Protect architectural woodwork during transit, delivery, storage and handling to prevent damage, spoilage, and deterioration.
- .3 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 Site Conditions paragraphs of Section 06 40 00.
- .4 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 changes in moisture content.

1.7 Site Conditions

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

Architectural Woodwork

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 10.

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 4.0 and additional or greater loading capacities as specified throughout the North American Architectural Woodwork Standards 4.0.
- .2 Maximum allowable adjustable shelf lengths shall comply with shelves assembly rules per the North American Architectural Woodwork Standards 4.0 based on shelf thickness indicated or scheduled.

2.2 Wood Materials

- .1 Lumber:
 - .1 Hardwood for concealed blocking and framing: Custom grade, any species that, when painted, will not show any defects.
 - .2 Moisture content: Provide kiln-dried (KD) lumber with moisture content range between 6% to 12% for interior architectural woodwork. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed 5% to 10%.

2.3 Panel Materials

- .1 Panel material schedule; except where indicated otherwise:
 - .1 Thickness: 19 mm (3/4") minimum.
 - .2 Core panels:
 - .1 At plastic laminate and melamine work: Particle board.
 - .2 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 Plywood:
 - .1 Veneer core plywood non telegraphing grain: Sanded good one side or good two sides (when both sides exposed or to receive applied finish materials) plywood:
 - .1 Hardwood plywood: in accordance with ANSI/HPVA HP-1-2009.
 - .2 Softwood plywood: to US Plywood Standard APA PS-1-19 Structural Plywood (with Typical APA Trademarks).
- .3 Particleboard:
 - .1 In accordance with ANSI A208.1-2009, 19 mm (3/4") minimum thickness and as follows:
 - .1 Industrial grade:

Architectural Woodwork

- .1 M-S Medium density; between 640 - 800 kg/m³ (40 - 50 lb/ft³).
- .2 M-3i Medium density; between 640 - 800 kg/m³ (40 - 50 lb/ft³).
- .2 Formaldehyde emission: No added urea-formaldehyde used in composition.

2.4 Plastic and Composite Materials

- .1 Low pressure decorative laminate; melamine particleboard panels:
 - .1 Particleboard conforming to ANSI A208.1-2009, grade M3i, board consisting of 100% pre-consumer wood fibre containing no added urea-formaldehyde resins, 19 mm (3/4") minimum thickness with thermally fused melamine resin impregnated decorative paper facing to ANSI/NEMA LD 3-2005, complete with matching non-yellowing edge trim, unless otherwise noted.
 - .2 Colours: as selected by *Consultant*.
 - .3 Provide 3 mm PVC edges where indicated or as scheduled.
- .2 High pressure decorative laminate:
 - .1 Post forming grade: in accordance with ANSI/NEMA LD 3-2005, Horizontal Performable Grade (HGP).
 - .2 Colours, finishes, and patterns: as selected by *Consultant*.
 - .3 Acceptable manufacturers/*Products*: Refer to Finish Schedule.

2.5 Fasteners and Adhesives

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

2.6 Hardware

- .1 Casework hardware; to be furnished and installed by the architectural woodwork manufacturer.
 - .1 Where casework hardware is not specified or indicated on drawings or scheduled, casework hardware shall comply with ANSI/BHMA Standards, latest edition, minimum grades, loading and other basic rules per the North American Architectural Woodwork Standards 4.0.
 - .2 Acceptable *Product*:
 - .1 Drawer slides:
 - .1 Accuride '3832 Heavy Duty Full Extension Ball Bearing Slides, 450 mm (18") extension'.
 - .2 Hinges:
 - .1 Hettich '110° Intermat 9943 Self Close Hinges and Clips complete with 6 way adjustability'.
 - .3 Pulls; doors and drawers, except where otherwise indicated:

Architectural Woodwork

- .1 Hafele '116.11.012, D-handle', stainless steel, 96 mm centre.
 - .1 Length: as indicated.
- .4 Locks: Full door lock tumblers, to later selection by *Consultant*.
- .5 Metal shelf supports:
 - .1 Richelieu 'CP5834180'.
 - .1 Load capacity: 20 kg.
 - .2 Finish: Nickel.
- .6 Substitutions permitted with approval by *Consultant*.

2.7 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.

2.8 Fabrication

- .1 Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises pre-cut, where possible, to receive hardware and other items of work.
- .2 Complete fabrication, assembly, finishing, hardware application, and other work before shipment to maximum extent possible. Trial fit in shop and disassemble components only as necessary for shipment and installation. Where necessary, provide ample allowance for scribing, trimming, and fitting. Reassemble with concealed fasteners.
- .3 Provide woodwork, solid tops and other indicated materials with pre-cut openings, where possible, for hardware, appliances, plumbing fixtures, electrical work, telephone cut-outs and similar items. Locate openings accurately and provide proper size and shape. Smooth edges of cut-outs and, where located in countertops, seal edges of cut-outs with a water-resistant coating.
- .4 Provide framing for architectural woodwork, complete with bracing and fastening devices as required for a rigid installation, and as required to sustain the imposed loads.
- .5 Reinforcing shown is minimum. Provide additional reinforcing as required to ensure a rigid assembly. Take responsibility for the stability of furniture and fitments.
- .6 Provide balancing sheets as required, and specified, complying with the North American Architectural Woodwork Standards 4.0.

Architectural Woodwork

- .7 Provide surface mount blocking and strapping necessary to support the work of this section. Such blocking shall not be exposed upon completion of work.
- .8 Prefinish work at the factory, except where specified or indicated otherwise.
- .9 Solid wood edging: No end grain shall be visible; mitre external corners; house internal corners.

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 grounds, nailers and other required fabrications which are to be built into other work when required.
- .4 Ensure that wall and ceiling variations are not in excess of 6.4 mm (1/4") in 3658 mm (144") and that floors are not in excess of 12.7 mm (1/2") in 3658 mm (144") of being plumb, level, flat, straight, square, of the correct size. Variations shall be corrected prior to installation of work of this section.
- .5 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

3.2 Installation

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

3.3 Installation - Tolerances

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

3.4 Adjusting and Cleaning

- .1 Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork.

Architectural Woodwork

- .2 Clean, lubricate, and adjust hardware.
- .3 Clean woodwork on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.5 Protection

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

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Thermal insulation forming part of the building envelope, including:
 - .1 Polyurethane foam (gap filler) insulation.

1.2 Submittals

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

1.3 Quality Assurance

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

1.4 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 10.

PART 2 - PRODUCTS

2.1 Polyurethane Foam (Gap Filler) Insulation

- .1 Polyurethane Foam for thermal insulation around exterior framing assemblies (Gap Filler):
 - .1 One-component CFC-free polyurethane foam in accordance with CAN/ULC S710.1-19.

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.

Thermal Insulation

- .3 Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- .4 Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness. Where multiple layers of insulation boards/batts are required, offset outer layer insulation board/batt joints 150 mm (6") from underlying insulation layer(s).
- .5 Install attachment at rate as required to prevent displacement of insulation boards during construction operations.
- .6 Butt joints tightly and offset vertical joints to form an unbroken thermal envelope. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .7 Apply insulation to ensure total and complete coverage of surfaces indicated to be insulated, and in direct contact with such surfaces.
- .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*.

3.2 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.

3.3 Field Quality Control

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

3.4 Protection

- .1 Comply with manufacturer's written requirements respecting protection.
- .2 Repair damage resulting from performance of work of this section in manner acceptable to *Consultant*.

END OF SECTION

Joint Firestopping and Smoke Seals

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Materials installed in joints to restrict the spread of fire and smoke.
 - .1 Joints in or between fire-resistance-rated constructions.
 - .2 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.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
 - .2 *Product* data sheets shall include the following information:
 - .1 Data and installation instructions for *Products* providing descriptions sufficient for identification at the *Place of the Work*.
 - .2 Materials list of *Products* proposed for use in the work of this section; complying with listed systems designs.
 - .3 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.
 - .4 Submit fire resistance rating test listings for firestopping and smoke seal systems.

Joint Firestopping and Smoke Seals

.3 Shop drawings:

- .1 Submit drawings indicating fire resistance rated assembly number, required temperature, hose stream, and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primers, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.
- .2 Designate on shop drawings static and dynamic joint systems, relative positions, expansion and control joints in rated slabs and walls, and firestopping details.
- .3 Engineered shop drawings; for engineering judgements:
 - .1 Where *Project* conditions require modification to an accredited third party testing agency's listed system design to address a particular firestopping condition that is not covered by a listed system, submit engineered shop drawings detailing the modifications to the listed system design as an engineering judgment or equivalent fire-resistance-rated assembly, for each *Project* location and condition.
 - .2 Submit the manufacturer's engineering judgment identification number and shop drawing details prepared by a professional engineer. The engineering judgment submittal shall include both *Project* name, *Project* location, and *Subcontractor's* name who will install firestop system as described in engineering judgement shop drawings.
 - .3 Provide complete details of specific application of listed system and its modifications upon which the engineered judgement is based upon.
 - .4 For perimeter fire barrier systems:
 - .1 Submit engineered shop drawings for engineering judgements covering perimeter fire barrier systems. Identify each cladding assembly type in contact with each perimeter fire barrier system.

.4 Manufacturers' instructions:

- .1 Manufacturer of *Products* proposed for use in work of this section shall prepare firestopping manual scheduling products to be used for each assembly and installation required in the *Work*.
 - .1 Coordinate with project firestopping manual specified under Section 01 33 00.
- .2 Manual shall include manufacturer's *Product* data sheets as specified under "*Product* data sheets" heading in Section 07 84 00.
- .3 Firestopping manual shall be submitted within 4 weeks of *Contract* award.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 10.
- .2 Submit the following for inclusion in the operation and maintenance manual:
 - .1 Letter signed by firestopping and smoke seal manufacturer on manufacturer's letterhead verifying that installed firestopping and smoke seal *Products* are suitable for the use indicated and comply with requirements of the *Contract Documents*.

Joint Firestopping and Smoke Seals

- .2 Letter signed by firestopping and smoke seal installer on installer's letterhead verifying that joint firestopping system installations are completed and that installations comply with listed systems designs and requirements of the *Contract Documents*.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers: Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval, training and certification of *Product* manufacturers.
 - .1 Submit proof of manufacturer's installer certification for each installer of firestopping and smoke sealant systems.
 - .1 Manufacturer's willingness to sell its firestopping *Products* to the *Contractor* or to an installer engaged by the *Contractor* does not in itself confer qualification on the buyer.
 - .2 Applicator shall designate a single individual as *Project* foreperson who shall be present at the *Place of the Work* at all times throughout the work of this section when the work of this section is being performed.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 10.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Manufacturers

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

Joint Firestopping and Smoke Seals

2.2 Performance/Design Requirements

- .1 Firestop and smoke sealant systems shall consist of material, or combination of materials installed to retain integrity of fire-rated construction by effectively impeding spread of flame, smoke, and/or hot gasses through perimeter joint or gaps, construction joints, or at perimeter fire containment in or adjacent to fire-rated barriers.
- .2 Smoke sealants applied over firestopping materials or combination smoke seal/firestop seal material shall form air tight barriers to prevent passage of gas and smoke.
- .3 Fire-resistance rating of firestopping system shall be equivalent to rating of adjacent floor, wall or other fire separation assembly.
- .4 Firestopping system at fire rated assemblies with assembly STC rating requirements shall provide STC rating equal to STC rating of fire rated assembly.
- .5 Confirm locations of exposed/non-exposed firestopping/smoke seal surfaces with *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 shall permit vertical movement allowing wall to move independent of structure due to forces including, but not limited to, live loads, dead loads, thermal expansion/contraction, and wind sway. Such movement shall not damage the wall assembly or its fire protection components.
 - .1 Provide head-of-wall joints with dynamic designation.
- .8 Regulatory requirements:
 - .1 Joint firestop systems shall be listed in accordance with CAN/ULC-S115-11 and shall achieve required fire resistance rating in accordance with building code.
 - .2 Proposed firestopping and smoke seal materials and methods shall conform to applicable governing codes having local jurisdiction.
- .9 Firestopping manual:
 - .1 *Contractor* and firestopping and smoke seal coordinator shall prepare a preliminary fire stopping manual, inclusive of all firestopping systems in the *Work*, to be submitted to the *Consultant* prior to the installation of any firestopping and smoke seal work.
 - .2 Manual shall include:
 - .1 Project key plans of each level, with enlarged key plans at areas where required, which identify and tag each anticipated penetration and fire stopping location and type (i.e. multiple metallic pipes through gypsum board wall assembly; single metallic pipe through concrete floor assembly, and the like)
 - .2 *Product* data sheets: data and installation instructions for *Products* providing descriptions sufficient for identification at the *Place of the Work*.
 - .1 Materials list of *Products* proposed for use in the *Work*; complying with listed systems designs.

Joint Firestopping and Smoke Seals

- .2 Listing agency's detailed drawing showing joint assemblies and firestopping materials, identified with listing agency's name and number or designation, fire rating achieved, and date of listing.
- .3 Manufacturers' installation instructions and recommendations.
- .3 Shop drawings:
 - .1 Submit drawings indicating fire resistance rated assembly number, required temperature, hose stream, and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primers, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.
 - .2 Designate on shop drawings static through penetrations and dynamic joint systems, relative positions, expansion and control joints in rated slabs and walls, and firestopping details.
 - .3 Engineered shop drawings; for engineering judgements:
 - .1 Where *Project* conditions require modification to an accredited third party testing agency's listed system design to address a particular firestopping condition that is not covered by a listed system, submit engineered shop drawings detailing the modifications to the listed system design as an engineering judgment or equivalent fire-resistance-rated assembly, for each *Project* location and condition.
 - .2 Submit the manufacturer's engineering judgment identification number and shop drawing details prepared by a professional engineer. The engineering judgment submittal shall include both *Project* name, *Project* location, and *Subcontractor's* name who will install firestop system as described in engineering judgement shop drawings.
 - .3 Provide complete details of specific application of listed system and its modifications upon which the engineered judgement is based upon.
 - .4 For perimeter fire barrier systems:
 - .1 Submit engineered shop drawings for engineering judgements covering perimeter fire barrier systems. Identify each cladding assembly type in contact with each perimeter fire barrier system.
 - .4 Fire resistance rating test listings for firestopping and smoke seal systems.
- .3 Firestopping manual shall be submitted within 4 weeks of *Contract* award.
- .4 Prior to concealment of firestopping conditions above a ceiling or by another assembly or finish, the *Contractor* shall submit an updated firestopping manual including as-built drawings that identify firestopping conditions and penetrations.

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.

Joint Firestopping and Smoke Seals

- .2 Firestopping and smoke seal systems shall conform to the following:
 - .1 Have a VOC limit of 250 g/L maximum, unless otherwise specified.
 - .2 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gasses in compliance with requirements of CAN/ULC-S115-11 and not to exceed opening sizes for which they are intended.
 - .3 Provide firestopping materials and systems with fire-resistance rating not less than the fire-resistance rating of applicable adjacent assembly.
 - .4 Listed in accordance with CAN/ULC-S115-11.
 - .5 Use only joint firestop systems that have been tested by an accredited third party testing agency for specific fire-rated construction conditions conforming to construction assembly type, joint type and fire-rating requirements for each separate instance.
 - .1 Where there is no specific third party tested and classified firestop system for a particular firestop configuration, submit engineered shop drawings.
 - .6 For joints in fire-separations, provide listed systems designs for the joint firestop and smoke seal systems as required by building code to maintain the integrity of the fire separations.
 - .7 *Products* shall be compatible with abutting dissimilar membranes, architectural coatings, finishes at floors, walls and ceilings. Check with requirements of *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 3 - EXECUTION

3.1 Preparation

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

3.2 Installation

- .1 Install joint firestopping and smoke seal systems in accordance with manufacturer's written requirements and in compliance with listed system designs. Products and installation requirements must comply with listed system designs.
- .2 For materials that will remain exposed after completing the *Work*, finish to achieve smooth, uniform surfaces. Tool or trowel exposed surfaces.
- .3 Notify *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.

Joint Firestopping and Smoke Seals

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 to be in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Examine completed firestop joint installations to ensure proper installation before concealing or enclosing areas. Keep areas of work accessible until inspections are completed.
 - .2 Inspection consultant to review installation of the work of this section and to perform random tests to verify its completion in accordance with the requirements of the *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 E2174-20a and ASTM E2393-20a. Independent inspection and testing company shall examine firestopping and shall determine, in general, that firestopping has been installed in accordance with requirements of the *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.
 - .2 Manufacturer's field review to be in accordance with Section 01 45 00.

END OF SECTION

Joint Sealants

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Joint sealants – exterior building envelope locations.
 - .2 Joint sealants – interior locations.
- .2 Section excludes:
 - .1 Glazing system assembly sealants.
 - .2 Mechanical and electrical sealants.
 - .3 Acoustic sealants.

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.
 - .2 Submit manufacturer's and *Product* name for each sealant which will be used in the *Work* prior to commencing the *Work*.
- .3 Samples:
 - .1 Submit "wet sample" sealant colour samples for each sealant *Product* and colour.
- .4 Test and evaluation reports:
 - .1 Test sealant in contact with samples of materials to be sealed to verify adhesion will be achieved and no staining of the material will result. Prepare sample joints at the *Place of the Work* of each type of sealant for each joint condition.
 - .1 Submit test results to *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 C1248-22.
 - .1 Submit test results to *Consultant* prior to application of sealants.

1.3 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 10.
 - .1 Include manufacturer's warranties.
- .2 Maintenance instructions:
 - .1 Submit maintenance instructions for all items for incorporation into the operation and maintenance manuals.

1.4 Quality Assurance

- .1 Qualifications:

Joint Sealants

.1 *Subcontractor:*

- .1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified.
- .2 Installer to comply with quality assurance articles referenced in ASTM C1193-16(2023) for installation of joint sealants.

1.5 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 10.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

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

2.2 Sealants

- .1 General:
 - .1 Colours: Sealant colours shall match colours of adjacent materials, as selected and approved by *Consultant*.
 - .1 Colours: shall be selected from manufacturer's full range of colours.
 - .2 In accordance with ASTM C920-18 and other requirements indicated for each liquid-applied chemically curing sealant, including those referencing ASTM C920-18 classifications for type, grade, class, and uses.
 - .3 For sealants to be applied to porous substrates:
 - .1 Provide products that have undergone testing in accordance with ASTM C1248-22 and have not stained porous joint substrates indicated for *Work*.
 - .4 Sealant supplied shall not exude any material(s) which travel into adjacent materials, or travel onto surfaces of adjacent materials; causing damage, or attracting soiling, which becomes apparent during the service life of the building.
- .2 Exterior sealants; joints in vertical and overhead surfaces:

Joint Sealants

- .1 Silicone sealant; high performance; 100% inorganic type:
 - .1 Single-component, non-sag, low to medium modulus non-bleed, high-performance silicone joint sealant, in accordance with the following: ASTM C920-18, Type S, Grade NS, Class 50 or greater.
 - .2 Provide low or medium modulus sealants as recommended by exterior wall cladding manufacturer.
 - .3 Acceptable *Products*:
 - .1 Low modulus:
 - .1 DOWSIL '790'.
 - .2 Momentive 'SCS2700 Silpruf LM.
 - .3 Sika 'Sikasil WS-290'.
 - .4 Tremco, Inc. 'Spectrem 1'.
 - .2 Medium modulus:
 - .1 DOWSIL '795'.
 - .2 Momentive 'SCS 2000 Silpruf'.
 - .3 Sika 'Sikasil WS-295'.
 - .4 Tremco, Inc 'Spectrem 2'.
- .3 Exterior general sealants; horizontal trafficable joints:
 - .1 General sealant:
 - .1 One-component, medium modulus sealant in accordance with the following: ASTM C920-18, Type M or S, Grade P or NS, Class 25.
 - .2 Acceptable *Products*:
 - .1 DOWSIL 'CCS'.
 - .2 DOWSIL 'CWS'.
 - .3 Momentive 'SWS'.
 - .4 Sika 'Sikasil WS-305 CN^{US}'.
 - .5 Sika 'Sikaflex 15LM'.
 - .6 Tremco, Inc. 'Vulkem 445SSL'.
- .4 Interior general sealants:
 - .1 VOC limit: Maximum 50 g/L, unless otherwise indicated.
 - .2 Interior sealant; at joints with painted gypsum board: one-component paintable acrylic in accordance with ASTM C834-17 Type OP; or polyurethane in accordance with ASTM C920-18 Type S, Grade NS, Class 35.
 - .1 Acceptable *Products*:
 - .1 Acrylic sealants:
 - .1 Master Builders Solutions Canada 'MasterSeal NP 520'

Joint Sealants

- .2 Tremco, Inc. 'Tremflex 834'.
- .2 Polyurethane sealants:
 - .1 Sika 'Sikaflex 1A'.
- .3 Substitutions permitted with approval by *Consultant*.
- .3 Interior sealant; at movement joints in vertical surfaces: one-component polyurethane sealant in accordance with the following: ASTM C920-18, Type M or S, Grade NS, Class 25.
 - .1 Acceptable *Products*:
 - .1 Master Builders Solutions Canada 'MasterSeal NP1'.
 - .2 Sika 'Sikaflex 15LM'.
 - .3 Tremco, Inc. 'Dymonic 100'.
 - .4 Substitutions permitted with approval by *Consultant*.
- .4 Interior sealant, mildew resistant one part silicone sealant in accordance with the following: ASTM C920-18, Type S, Grade NS, Class 25.
 - .1 Acceptable *Products*:
 - .1 DOWSIL '786'.
 - .2 Momentive 'Sanitary SCS1700 Sealant'.
 - .3 Sika 'Sikasil GP'.
 - .4 Tremco, Inc. 'Tremsil 200'.

2.3 Accessories

- .1 General: Provide joint sealants, primers, backings, and fillers that are compatible with one another and with joint substrates and other sealants or joint fillers specified and approved for applications indicated under joint sealant scheduled and under conditions of service and application as demonstrated by joint sealant manufacturer based on proven test results and field experience. When incompatible, inform *Consultant* and change to compatible type acceptable to *Consultant*.
- .2 Cylindrical sealant backings: Provide joint backings that meet ASTM C1330-18, 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.

Joint Sealants

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

PART 3 - EXECUTION

3.1 Manufacturer's Recommendations

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

3.2 Preparation

- .1 Protect adjacent work areas and finished surfaces from damage during joint sealant installation.
- .2 Clean and prepare joint surfaces and substrates in accordance with ASTM C1193-16(2023) and outlined by joint sealant manufacturer's written requirements.
- .3 Prepare rusting or scaling surfaces using abrasive cleaning methods as recommended by joint sealant manufacturer prior to joint sealant installation. Remove and neutralize efflorescence, mould, mildew and algae prior to joint sealant installation.
- .4 Prepare finish-coated surfaces per joint sealant manufacturer's specific recommendations.
- .5 Test materials for indications of staining or poor adhesion before any sealing is commenced. Submit reports in writing to *Consultant* of results.
- .6 Do not proceed with installation of joint sealants under the following conditions:
 - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer, or are below 5°C (40°F).
 - .2 When joint substrates are wet.
 - .3 Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
 - .4 Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

Joint Sealants

3.3 Masking

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

3.4 Installation

- .1 Install in accordance with joint sealant manufacturer's installation written requirements for products, primers and applications indicated unless more stringent project-specific instructions or requirements apply.
- .2 Apply joint sealants for continuous waterproof sealant joint protection. Lap vertical joints over horizontal joints as recommended by sealant manufacturer. Comply with installation recommendations in ASTM C1193-16(2023) for use of joint sealants as applicable to each specific sealant installation.
- .3 Install sealant primers only when recommended by sealant manufacturer and demonstrated at pre-construction tests after joint surface preparation has been completed and when surfaces are verified as clean and dry. Allow any primer installation to completely dry or cure prior to installation of backing or joint sealants. Primer is mandatory for gun applied sealants.
- .4 Install joint sealants using proven techniques that comply with the following and in proper sequence with installation of primers and backings.
 - .1 Using proper joint sealant dispensing equipment, place sealants by pushing sealant beads into opening to fully wet-out joint sealant substrates. Fill sealant joint opening to full and proper configuration.
 - .2 Provide uniform cross-sectional shapes and depths in relation to joint width for optimum sealant movement capability per joint sealant manufacturer's written requirements.
- .5 Joint sealant tooling is required for non-sag joint sealant installations. Immediately after placing fresh sealants and before skinning or curing begins, tool sealants using metal spatulas designed for this purpose in accordance with manufacturer's recommendations. Provide a smooth, uniform sealant finish, eliminating air pockets and ensuring good contact for optimum sealant adhesion within each side of the joint opening.
 - .1 Provide concave joint configuration as indicated per figure 5-A in ASTM C1193-16(2023) unless otherwise indicated.
 - .2 Use tooling agents that are approved in writing by sealant manufacturer and that do not discolour sealants or adjacent surfaces.
 - .3 Remove excess sealant from surfaces adjacent to joint openings using metal spatula, promptly cleaning any sealant residue from adjacent finished surfaces. Remove masking after joint sealant is installed.
- .6 Allow single-component sealants to fully cure before adhesion testing is performed as recommended by joint sealant manufacturer.
- .7 Match approved sealant mock-up for colour, finish and overall aesthetics. Remove, refinish or re-install work not in compliance with the *Contract Documents*.
- .8 When surfaces of adjacent materials are to be painted, perform sealant work before these surfaces are painted.

Joint Sealants

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

3.5 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.
 - .5 Perimeters of mechanical and electrical penetrations including but not limited to outlets and electrical boxes.

Joint Sealants

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 Mildew resistant sealant:
 - .1 Counter/wall junctions at countertops.
 - .2 At wet areas.
 - .3 At resilient flooring and resilient base.

3.7 Field Quality Control

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

3.8 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.

3.9 Protection

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

END OF SECTION

Metal Supports for Gypsum Board

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Metal support systems for interior gypsum board assemblies.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the *Work* of this section, including additional data as may be required to demonstrate compliance with the *Contract Documents*.
- .3 Test and evaluation reports:
 - .1 Submit certified test results for each required fire resistance rated assembly for work of Section 09 22 00.

1.3 Quality Assurance

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

PART 2 - PRODUCTS

2.1 Performance/Design Requirements - 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 Sheet metal thicknesses specified in Section 09 22 00 indicate the minimum base steel thickness excluding coating.
- .2 Protective coatings for metal supports and framing:
 - .1 Minimum corrosion protection: Z120 (G40) ASTM A653/A653M-18.
 - .2 Heavy duty corrosion protection where scheduled or indicated: Z275 (G90) ASTM A653/A653M-18.
- .3 Sheet metal screws: 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:

Metal Supports for Gypsum Board

- .1 Steel screws: equal to or exceeding 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: in accordance with ASTM C645-24; roll formed from galvanized steel sheet, minimum thickness 0.455 mm (0.0179") unless otherwise specified, indicated, or recommended by gypsum board manufacturer. Provide service holes starting at 450 mm (18") from bottom, then 914 mm (36") on centre to top of studs.
 - .1 Steel studs; at backer plate locations: 0.836 mm (0.0329") minimum thickness.
 - .2 Steel studs at abuse resistant gypsum board locations: 0.836 mm (0.0329") minimum thickness.
- .2 Interior floor and ceiling tracks (runners): in accordance with ASTM C645-24; in widths to suit stud sizes.
 - .1 Metal thickness: to match studs.
 - .2 For openings wider than 914 mm (36"), provide 0.836 mm (0.0329") minimum thickness for header.
- .3 Interior floor and ceiling track (runner) fasteners:
 - .1 To concrete and masonry: Use stub nails or power-driven fasteners.
 - .2 To suspended acoustic ceiling tile grid: Manufactured to fit applicable ceiling grid profile:
 - .1 Acceptable *Products*:
 - .1 CGC 'Partition Clip'.
 - .2 Substitutions permitted with approval by *Consultant*.
- .4 Bracing channels: Minimum 19 mm x 10 mm x 1.087 mm (3/4" x 3/8" x 0.0428") cold rolled galvanized steel.

2.4 Ceiling Support Materials and Systems

- .1 General: Size ceiling support components in accordance with ASTM C754-20 unless otherwise indicated.
- .2 Main runners: Steel channels, hot or cold rolled; Z180 (G60) galvanized.
- .3 Hanger wire:
 - .1 In accordance with ASTM A641/A641M-19, soft, Class 1 galvanized, minimum 4.064 mm (0.160", 8 AWG).
- .4 Hanger rods and flats: Mild steel with zinc coating, galvanized for exterior applications.
 - .1 General: Size devices for 5 times load imposed by completed system as determined in accordance with ASTM E488/E488M-22.

Metal Supports for Gypsum Board

- .2 Screws, clips, bolts, concrete inserts or other devices for ceiling hangers whose suitability for use intended has been proven through standard construction practices or by certified test data.
- .3 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.
- .4 Hangers: in accordance with ASTM C754-20 for maximum ceiling area and loads to be supported.
- .5 Interior concrete ceiling anchors:
 - .1 Acceptable *Products*:
 - .1 ITW Ramset/Red Head 'Dynabolt Sleeve Anchor TW-1614' or 'Redi-Drive Tie Drive' or 'Redi-Drive' with angle clip.
 - .2 ITW Ramset/Red Head 'Trubolt' or 'Dynabolt' anchors complete with galvanized angle clip.
 - .3 Hilti 'Kwik-Bolt 3' and 'HHDCa 1/4 Ceiling Hangers'.
 - .4 Substitutions permitted with approval by *Consultant*.
- .5 Tie wire: 1.19 mm (0.047", 18 AWG) minimum zinc coated, soft-annealed wire, in accordance with ASTM A641/A641M-19.
- .6 Furring anchorages: 1.62 mm (0.0637", 16 AWG) galvanized wire ties, manufacturer's standard wire type clips, bolts, nails or screws as recommended by furring manufacturer and in accordance with ASTM C754-20.
- .7 Runner (carry) channels: 1.367 mm (0.0538") thick cold rolled steel, in accordance with ASTM C754-20, with minimum 228 MPa yield strength:
 - .1 38 mm x 12.7 mm (1-1/2" x 1/2") where supported at centres of 914 mm (36") maximum.
 - .2 38 mm x 19 mm (1-1/2" x 3/4") where supported at centres of 1220 mm (48") maximum.
 - .3 Finish: primer painted or zinc coated.

2.5 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 Z-furring members: Galvanized steel z-shaped furring members; in accordance with ASTM A653/A653M-18, G60, 0.836 mm (0.0329") minimum thickness of base metal, of depth indicated, designed for mechanical attachment of insulation boards or blankets.
- .3 Fasteners for furring members: Type and size recommended by furring manufacturer for substrate and application indicated, load rating, and spacing to support materials carried by assembly with factor of safety of 3x per fastener manufacturer data sheets.

2.6 Accessories

- .1 Backer plates:

Metal Supports for Gypsum Board

- .1 Metal backer plates: Steel, galvanized; fastened to studs for attachment of surface mounted fittings and accessories minimum 150 mm (6") wide x length and width to suit size of items to be attached; x minimum base metal thickness as follows:
 - .1 0.836 mm (0.0329").
- .2 Plywood backer plates: Softwood plywood in accordance with Section 06 10 53; 19 mm (3/4") minimum x length and width to suit size of items to be attached; fastened to studs for attachment of surface mounted fittings and accessories.
- .3 Elimination of backer plates or direct attachment of accessories or equipment to studs shall not be permitted.

PART 3 - EXECUTION

3.1 Installation General

- .1 Install in accordance with ASTM C754-20 and manufacturer's written requirements, except as modified by Section 09 22 00. Do not bridge building expansion joints with support system. Frame both sides of joints with furring and other supports as indicated.
- .2 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 Cooperate with and give direction to trades erecting framing and furring over which the work of Section 09 22 00 is applied. Coordinate finished joint location with framing.
- .4 Coordinate installation and cooperate with mechanical and electrical work to accommodate mechanical electrical items and any other work required to be incorporated into or coordinated with the partitions, ceiling and soffit systems.
 - .1 Where the presence of suspended ductwork or other mechanical or electrical services or devices above ceiling framing conflicts with ceiling framing suspension points from structure above, provide bridging framing below conflicting work as required to support ceiling framing on specified intervals.
 - .2 Do not suspend ceiling framing from mechanical or electrical suspension systems unless agreement is obtained in writing from engineer for *Subcontractor* installing such framing that additional imposed loads are acceptable; obtain *Consultant's* acceptance before proceeding.
- .5 Provide clearances between work of Section 09 22 00 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.

Metal Supports for Gypsum Board

- .7 Size framing systems in accordance with 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 backer plates to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of Section 09 22 00.

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, and erected to maintain finish gypsum board line dimensions and contours. Make allowance for thermal movement.
- .4 Thermally separate metal studs from exterior concrete or masonry.

3.4 Suspended and Furred Ceilings

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

Metal Supports for Gypsum Board

3.5 Wall Furring

- .1 Install steel furring for braced walls, free standing walls, walls that are furred out as indicated.
- .2 Frame openings and around built-in equipment, cabinets, access panels, on 4 sides, with channels. Extend furring into reveals. Check clearances with equipment suppliers.
- .3 Provide bulkheads and boxed-in duct shafts, for beams, columns, pipes and around exposed services where indicated. Install 19 mm (3/4") channels at corners and at 305 mm (12") on centre.

3.6 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.

Metal Supports for Gypsum Board

- .9 Coordinate work with others installing horizontal runs of service lines so that work is done simultaneously. Where standard holes are too small for installed services, notch studs, and splice notched flanges with splice pieces 305 mm (12") longer than notches, each fastened with 2 screws.
- .10 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .11 Coordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other sections.
- .12 Unless otherwise indicated, partitions, together with gypsum board facings, shall extend above ceilings to underside of structure above.
- .13 Chase walls:
 - .1 Provide chase walls consisting of two parallel steel stud partitions.
 - .2 Provide cross bracing consisting of metal furring, located at quarter points on each pair of studs. Attach cross bracing to studs with metal screws.
- .14 Lateral support bracing channels:
 - .1 Stiffen partitions over 3 m (10') in vertical span, at mid-height to maximum vertical spacing of 2440 mm (8') on centre, with at least one 19 mm (3/4") horizontal bracing channel, extending full length of partition, overlapping at least two stud spaces at ends of bracing channels.
 - .2 Stiffen partitions at not more than 150 mm (6") from the top and bottom of openings and across two full stud spaces at each side of openings with horizontal bracing channel.

3.7 Control Joints

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

3.8 Concrete Anchors

- .1 Provide anchors and anchorage points in reinforced concrete floor slab underside in accordance with gypsum board manufacturer's suspension requirements. Drill holes with carbide-tipped drill bits in accordance with ANSI B212.15-1994 (R2000).
- .2 Provide anchors; minimum installation depth, and method of expansion as recommended by the anchor manufacturer.

END OF SECTION

Gypsum Board

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Gypsum board; wall and ceiling applications.
 - .2 Gypsum board accessories and miscellaneous related materials.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Indicate control joint locations.
 - .2 Indicate access door and panel locations including sizes and finishing requirements.
- .4 Fire-rated assembly listings and STC assembly ratings:
 - .1 Submit fire-rated assembly listings for each required fire resistance rated assembly for work of this section.
 - .2 Submit STC assembly ratings for each required STC rated assembly for work of this section.

1.3 Quality Assurance

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

1.4 Product Handling

- .1 Product handling shall be in accordance with Section 01 61 00 as supplemented by the requirements of Section 09 29 00.
- .2 Handle gypsum panel products and accessories in accordance with GA 216-24 and GA 801-23.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Single source responsibility:
 - .1 Provide gypsum board *Products* from one manufacturer for the work of this section.
- .2 Fire resistance rating:

Gypsum Board

- .1 Construct fire resistance rated assemblies in accordance with listing and CAN/ULC S101-14.
- .3 Paper-faced gypsum board: in accordance with ASTM C1396/C1396M-17.
- .4 Fire rated in accordance with listed assemblies where indicated: Type X or Type C.

2.2 Gypsum Board Panels

- .1 GB-1; Gypsum board; paper faced:
 - .1 Acceptable *Products*:
 - .1 CertainTeed 'Type X and Type C'.
 - .2 CGC 'SHEETROCK Brand Firecode X and Firecode C'.
 - .3 Georgia-Pacific 'ToughRock Fireguard X Gypsum Board and ToughRock Fireguard C Gypsum Board'.
 - .4 PABCO Gypsum 'QuietRock ES'.
 - .2 GB-2; Gypsum board; fire-rated, paper faced:
 - .1 Acceptable *Products*:
 - .1 CertainTeed 'Type X and Type C'.
 - .2 CGC 'SHEETROCK Brand Firecode X and Firecode C'.
 - .3 Georgia-Pacific 'ToughRock Fireguard X Gypsum Board and ToughRock Fireguard C Gypsum Board'.
 - .4 PABCO Gypsum 'QuietRock ES'.
 - .3 Gypsum board; abuse resistant:
 - .1 Mould and moisture resistant: in accordance with ASTM D3273-16, with a panel score of 10.
 - .2 Abuse resistance performance in accordance with ASTM C1629/C1629M-18:
 - .1 Surface abrasion surface damage: Level 3.
 - .2 Surface indentation surface damage: Level 1.
 - .3 Soft-body impact penetration: Level 2.
 - .4 Hard Body Impact resistance: Level 1.
 - .3 Paper faced:
 - .1 Acceptable *Products*:
 - .1 CertainTeed 'Air-Renew Extreme Abuse Resistant' Gypsum Board.
 - .2 CertainTeed 'Extreme Abuse' Gypsum Board with M2Tech'.
 - .3 CGC 'Sheetrock Brand Panels Mold Tough AR Firecode X'.

2.3 Attachment Materials

- .1 Screws; for gypsum board: bugle head, fine thread, self-tapping, Type G, Type W, Type S, or Type S-12 to suit framing type and metal gauge in accordance with GA GA 216-24, with corrosion resistant finish, and in accordance with ASTM C1002-07/ASTM C954-18.

Gypsum Board

- .1 Screw sizing:
 - .1 #6 x 25 mm (1") for single thickness board fastening.
 - .2 #6 x 32 mm (1-1/4") for single thickness 15.9 mm (5/8") board fastening.
 - .3 #7 x 41 mm (1 5/8") for double thickness board fastening.
 - .4 25.4 mm (1"), 41 mm (1-5/8"), and 51 mm (2") for triple thickness board fastening, at stud locations, and 38 mm (1-1/2") Type G screws for attaching face sheet to base sheets, in accordance with board manufacturer's written requirements.

2.4 Accessories

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

Gypsum Board

2.5 Related Support Assemblies and Backer Plates

- .1 Metal support systems and backer plates at interior assemblies: in accordance with Section 09 22 00.

2.6 Joint Treatment Materials

- .1 General: in accordance with ASTM C475/C475M-17(2022).
- .2 Joint tape: in accordance with manufacturer's written requirements.
- .3 Joint compound for interior gypsum board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - .1 Prefilling: Use setting-type compound as recommended by panel board manufacturer.
 - .2 Embedding and first coat: Use setting-type or taping compound as recommended by panel board and trim accessory manufacturers.
 - .3 Fill and finish coats: Use sanding type setting-type or taping compound as recommended by panel board manufacturer.

2.7 Acoustic Wall Assembly Materials

- .1 Acoustic sealant; concealed locations: to meet material requirements as listed in Part 9 of ASTM C919-24, including ASTM C834-17 or ASTM C920-18:
 - .1 Acceptable *Products*:
 - .1 Hilti Canada Corp 'CS-S SA Light'.
 - .2 Owens Corning 'QuietZone Acoustic Sealant'.
 - .3 Pecora 'BA-98'.
 - .4 Pecora 'AC-20 FTR'.
 - .5 Tremco 'Tremflex 834'.
 - .6 Substitutions permitted with approval by *Consultant*.
- .2 Acoustic sealant; exposed locations, acrylic:
 - .1 Acrylic/latex acoustic sealant, Type S, Grade NS, Class 12.5 in accordance with ASTM C920-18, maximum VOC content 60 g/L, non-hardening or ASTM C834-17, Type OP, Grade -18° C.
 - .2 For exposed sealants use paintable sealant products, do use non-skinning type products where they are exposed to view or where sealant products may deteriorate (stain or bleed into) into painted surfaces.
 - .3 Acceptable *Products*:
 - .1 Hilti Canada Corp 'CS-S SA Light'.
 - .2 Master Builders Solutions Canada 'MasterSeal NP 520'.
 - .3 Owens Corning 'QuietZone Acoustic Sealant'.
 - .4 Pecora 'AC20 FTR'.
 - .5 Tremco 'Tremflex 834'.

Gypsum Board

- .6 Substitutions permitted with approval by *Consultant*.
- .3 Smoke and acoustic sealant; concealed and exposed locations, non-fire-rated acoustic assemblies:
 - .1 Acrylic smoke and acoustic sealant, in accordance with ASTM C834-17 maximum VOC content 60 g/L, paintable, Flame Spread Value of maximum 25 in accordance with CAN/ULC-S102-10.
 - .2 Sealant shall not deteriorate (stain or bleed into) painted surfaces.
 - .3 Acceptable *Products*:
 - .1 Hilti Canada Corp 'CS-S SA Light'.
 - .2 Tremco 'Tremstop Smoke & Sound Sealant'.
 - .3 Substitutions permitted with approval by *Consultant*.
- .4 Acoustic sealant for plenum locations: Smoke-seal sealant with flame-spread not more than 25 and smoke developed classification not more than 50 in accordance with CAN/ULC-S102-10, in accordance with Section 07 84 00.
- .5 Acoustic compound: premixed perlite plaster.
- .6 Acoustic (sound attenuation) insulation:
 - .1 Mineral-fibre formaldehyde-free sound attenuation batts: in accordance with CAN/ULC S702.1-14, Type 1, non-combustible in accordance with CAN/ULC-S114-18, formaldehyde-free.
 - .1 Acceptable *Products*:
 - .1 CertainTeed 'Sustainable Insulation NoiseReducer'.
 - .2 Johns Manville 'Sound-SHIELD'.
 - .3 Owens-Corning 'QuietZone'.
 - .4 Rockwool 'AFB evo'.
 - .5 Substitutions permitted with approval by *Consultant*.
 - .2 Fasteners: use mechanical fasteners where required to secure insulation into position in accordance with insulation manufacturer.

2.8 Access Doors

- .1 Access doors: in accordance with Divisions 21, 22, and 23 and Divisions 26, 27, and 28.

PART 3 - EXECUTION

3.1 Board Installation - General

- .1 Before installation of board commences, verify that internal services have been installed, tested, and approved; conduits, pipes, cables, and outlets are plugged, capped, or covered; and that fastenings and supports are in place.
- .2 Remove debris and rubbish from wall and ceiling cavities before enclosing with board.
- .3 General:

Gypsum Board

- .1 Installation shall be in accordance with ASTM C840-18b, GA 216-24, GA 214-21, GA 600-24, and manufacturer's written requirements, except as otherwise indicated.
- .4 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.
- .5 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.
- .6 Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cut-outs.
- .7 Apply components of fire-rated assemblies in conformance with indicated designs.
- .8 Do not apply gypsum board in close proximity to hot pipes or heating ducts.
- .9 Apply board with long dimension perpendicular to supports, unless otherwise indicated.
- .10 Locate joints on opposite sides of partitions on different studs, and at least 305 mm (12") from opening jambs.
- .11 Install materials with the minimum number of joints. Tightly butt joints, without force, and neatly align them.
- .12 Form smooth joints at ends and at field cut edges of board panels.
- .13 Frame openings on every side. Provide clearances with services.
- .14 Work shall include bulkheads over doors, frames, screens, and changes in ceiling levels, pipe space and as indicated.
- .15 Provide clearances between work of this section and structural elements to prevent transference of structural loads in accordance with Section 09 22 00.
- .16 Fasten board to metal support members by metal gypsum board screws, 9.5 mm (0.374") minimum to, and 12.7 mm (1/2") maximum from, centre of joints.
 - .1 Space screws:
 - .1 At fire rated board as per fire-rated assembly.
 - .2 At typical board walls at 400 mm (16") on centre at edges and field unless otherwise required.
 - .3 At typical board ceilings at 305 mm (12") on centre at edges and field unless otherwise required.
- .17 No joint will occur within 305 mm (12") of the corner of an opening.
- .18 Locate gypsum panel product joints so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.
- .19 Tolerances:
 - .1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane in exposed surfaces, except at end joint between gypsum board panels.
 - .2 Do not exceed 10 mm (3/8") from indicated location.

Gypsum Board

- .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 Fire Separations

- .1 Install fire-rated assemblies in accordance with assembly listing requirements in order to obtain fire ratings indicated and as required by authorities having jurisdiction.
- .2 Vertical bulkheads in ceiling spaces over fire rated partitions, doors and the like shall have same fire rating as the partition over which they occur. Such bulkheads shall be of gypsum board construction unless otherwise indicated.
- .3 Use fire rated gypsum wallboard as specified.
- .4 Where lighting fixtures, diffusers, and the like are recessed into fire rated ceilings or bulkheads, provide enclosure to maintain required fire rating. Form removable panel to give access to fixture outlet box.
- .5 Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide gypsum board enclosure or backing to maintain required fire rating, unless otherwise detailed.
 - .1 To form convex surfaces, begin installation at one end of the curved surface and fasten panel to studs as it is wrapped around the curve.
 - .2 To form concave surfaces, start fastening panel to the stud at the centre of the curve and work outward to the panel ends.

3.3 Abuse Resistant Board Installation

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

3.4 Acoustic Wall Assemblies

- .1 Acoustical sealant and plaster:
 - .1 Apply acoustical sealant to seal gaps in accordance with ASTM C919-24 and in accordance with the STC rated assembly.
 - .2 Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Locate edge trim and close off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings, in accordance with ASTM C919-24 and manufacturer's written requirements.
 - .3 Clean substrate, remove debris and deleterious substances.

Gypsum Board

- .4 Apply sealant to close voids; no leaks around track and gypsum board.
- .2 Sound attenuation insulation:
 - .1 Install sound attenuation insulation to fill cavity unless otherwise indicated.
 - .2 Trim insulation to provide close-fit contact to framing assemblies and fill the partition cavity or acoustic insulation assemblies to thicknesses specified or indicated.
 - .3 Maintain air space between backs of sound attenuation insulation and back of opposite partition face layer, as applicable.
 - .4 Cut insulation to provide close-fit contact around electrical boxes, pipes, and other obstructions and penetrations through and within acoustic assemblies.
 - .5 Extend acoustic partition assemblies to underside of structure. Incorporate approved provision to prevent transmittance of structural deflection to partition assembly.
 - .6 Staple sound attenuation insulation where required by manufacturer's installation requirements.
 - .7 Where studs are not faced with gypsum board on both sides, mechanically fasten wire mesh to non-faced side of stud to retain insulation.
 - .8 Mechanically attach sound attenuation insulation in wall assemblies where cavity of wall assembly is greater than 150 mm (6").
 - .9 Secure insulation in such a manner that it will not sag or settle away from required locations.
- .3 Sound flanking paths:
 - .1 Where sound rated partition walls intersect non rated gypsum board partition walls, extend sound rated construction to completely close sound flanking paths through non rated construction in accordance with ASTM C919-24 and with manufacturer's written requirements.
 - .2 Seal joints between face layers at vertical interior angles of intersecting partitions.

3.5 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.

Gypsum Board

- .2 End joints shall be flush aligned to maximum offset of 0.5 mm (0.020").

3.6 Access Doors

- .1 Install access doors as supplied by Divisions 21, 22, and 23 and Divisions 26, 27, and 28.
- .2 Install access panels in locations to be determined by coordination with trades installing mechanical, electrical and other building services. Locations to be reviewed and confirmed by *Consultant*.
- .3 Rigidly secure frames to furring or framing systems.

3.7 Finishing

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

Gypsum Board

- .4 Cover fastener heads and accessories with 1 coat of joint compound.
- .4 Second coat (Level 3): After first coat treatment is dried, apply second coat of compound over tape and trim, feathering compound 50 mm (2") beyond edge of first coat.
 - .1 Cover fastener heads and accessories with total of 2 separate coats of joint compound.
- .5 Third coat (Level 4):
 - .1 After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 50 mm (2") beyond edge of second coat.
 - .2 Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
 - .3 Finished joints will be accepted with a camber not greater than 1 mm (1/32") and shall be seamless, plumb, true and flush and with square, neat corners.
 - .4 Cover fastener heads and accessories with total of 3 separate coats of joint compound.
 - .5 Where new partitions align with existing gypsum board, apply required amount of skim coats to make transition inconspicuous from a distance of 914 mm (36").
 - .6 Completed installation at interface between new and existing construction shall provide an inconspicuous joint.
- .3 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").
- .4 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.
- .5 Control joints:
 - .1 Provide control joints set in board facing. Support control joints with studs or furring channels on both sides of joint.
 - .2 Provide control joints in locations required and as indicated on reviewed shop drawings.

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, or building control element) in the building structure.
- .4 Install control joints where a wall or partition runs in an uninterrupted straight plane exceeding 9100 mm (30 linear feet).
- .5 Install control joints in interior ceilings:
 - .1 With perimeter relief:
 - .1 Linear dimensions between control joints shall not exceed 15000 mm (50 ft) and total area between control joints shall not exceed 230 m² (2500 ft²).
 - .2 Without perimeter relief:
 - .1 Linear dimensions between control joints shall not exceed 9100 mm (30 ft) and total area between control joints shall not exceed 84 m² (900 ft²).
- .6 Install control joints where ceiling framing members change direction.
- .7 Where a control joint occurs in an acoustical or fire-rated system, provide blocking behind the control joint by using a backing material such as 16 mm (5/8") Type X gypsum panel products, mineral fibre, or other tested equivalent. Construct through-wall control joints at fire-rated assemblies in accordance with assembly listing requirements.
- .8 Line up control joints with joints in other construction or with centre lines of mullions, columns, piers, or similar building elements, where accepted by *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 Locate board joints so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.

3.8 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

Acoustical Tile Ceiling Systems

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Acoustical tile ceiling systems; ACT-1.

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.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit manufacturer's standard details.
 - .2 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines, and acoustical unit support at ceiling fixture.
 - .3 Submit reflected ceiling plans for special grid patterns as indicated.
- .4 Samples:
 - .1 Submit sample of each component of ceiling system. Samples shall fully represent materials to be supplied in colour, texture, finish and construction.
 - .2 Submit samples, load test data and design tables for each type of insert to be used in the *Work* for hanger supports.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 10.
- .2 Maintenance data:
 - .1 Submit maintenance and cleaning instructions for acoustical ceiling systems for incorporation into the maintenance manuals.
- .3 Maintenance materials:
 - .1 Deliver for maintenance use, 2% of each type and colour of suspension components and acoustical tiles used in the *Work*.

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 Installers: Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified.

1.6 Site Conditions

- .1 Interior temperature of building shall be between 15°C and 30°C, and relative humidity shall be 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.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 10.
- .2 Extended warranties:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Design suspension systems for a maximum mid-span deflection not exceeding L/360 in accordance with ASTM C635/C635M-22 deflection test.
- .2 Design suspension system to support safely, and without distortion, the superimposed loads of:
 - .1 Air supply diffusers and return grilles.
 - .2 Lighting fixtures.

2.2 General

- .1 Single source responsibility: Obtain each type of acoustical ceiling unit and suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the *Work*. Products installed as part of the work of this section shall be from same production run.

2.3 Acoustical Tiles

- .1 Lay-in acoustical tiles: Refer to Finish Schedule.

Acoustical Tile Ceiling Systems

2.4 Metal Suspension Systems

- .1 Hanger anchorage devices: Screws, clips, bolts, concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3 x calculated load supported except size direct pull-out concrete inserts for 5 x calculated loads.
- .2 Concrete hanger anchors; post installed: Steel eye bolts and nuts to suit ceiling hangers with capability to sustain, without failure, a load equal to 4 times that imposed by ceiling construction, as determined by testing per ASTM E488/E488M-22, conducted by a qualified independent testing laboratory.
 - .1 Dynabolt Sleeve Anchor 'TW-1614' or Readi-Tie-Drive 'TD4-112' tie wire anchor by ITW Ramset/Red Head.
 - .2 Kwik-Bolt III 'HHDCA 1/4' tie wire anchor by Hilti Corporation.
 - .3 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.
- .3 Hangers and tie wire: Galvanized wire, recommended by manufacturer of suspension system, minimum 2.66 mm (0.1") (12 gauge).
- .4 Suspension system accessories:
 - .1 Splices, clips, and perimeter moulding, of manufacturer's standard type to suit the applicable conditions unless special conditions and access area are shown or specified.
- .5 Standard suspension system, non fire-rated:
 - .1 Intermediate duty in accordance with ASTM C635/C635M-22, 24 mm (15/16") interlocking tee system, designed to support acoustical panels in patterns indicated with deflection of main tees less than L/360, consisting of main tees and cross tees. The system shall provide lock joint intersections of cross and main tees.
 - .2 Acceptable *Products*:
 - .1 Refer to Finish Schedule.

2.5 Miscellaneous Materials

- .1 Acoustical sealant: Non-drying, non-hardening, non-skinning, non-staining, non-bleeding, gunnable sealant complying with requirements specified in Section 07 92 00.

2.6 Metal Finish

- .1 Metal exposed in finished work shall have a pre-coated baked enamel finish in non-yellowing colour. Submit paint formulation of grid system to lighting fixture, speaker grille, sprinkler and diffuser manufacturers to ensure consistency of colour, sheen and texture of exposed metal components in the ceiling assemblies.
 - .1 Colour: Flat white.

Acoustical Tile Ceiling Systems

PART 3 - EXECUTION

3.1 Installation - General

- .1 Install ceiling panels and metal suspension system in accordance with manufacturer's directions. Where manufacturer's directions are at variance with *Contract Documents*, notify *Consultant* before proceeding with installation.
- .2 Do not commence installation until work above suspended ceiling has been completed, inspected and accepted.

3.2 Installation - Suspension System

- .1 Install suspension system rigid, secure, square, level and plumb, framed and erected to maintain dimensions and contours indicated, and in accordance with ASTM C636/C636M-19, Cisca installation standards and any other applicable national or local code requirements. Make allowance for thermal and structural movement.
- .2 Attach hangers to structure with inserts and hanger supports. Do not use powder activated fasteners.
- .3 Support hangers for suspended ceiling grid independent of walls, columns, pipes and ducts.
- .4 Space hangers for ceilings at maximum 1220 mm (48") on centre in both directions. Provide additional hangers as required to comply with manufacturer's written installation requirements.
- .5 Locate hangers at not more than 150 mm (6") from ends of main tee members.
- .6 Install exposed tee members to pattern indicated. Securely attach hangers to main tee members.
- .7 Exposed tees shall be as long as possible to minimize joints. Make joints square, tight, flush and reinforce with splines. Distribute joints to prevent clustering in one area.
- .8 Space tee bars to suit ceiling panels and as detailed, and to accommodate lighting fixtures, diffusers and return grilles.
- .9 Cooperate in the installation of ceiling systems, making adjustments where required to ensure that the lighting fixtures, supply diffusers, exhaust grilles and other built-in items properly fit into ceiling module and finish flush with rest of ceiling.
- .10 Restrict creep inside module panels so that strips are centred on module lines.
- .11 Install edge moulding as detailed where ceiling abuts vertical surfaces. Lap corners, use maximum lengths to minimize joints. Make joints square, tight and flush.
 - .1 Screw attach mouldings to substrates at intervals not more than 400 mm (16") on centre and not more than 210 mm (8") from ends, levelling with suspension system. Lap corners accurately and connect securely.

3.3 Installation - Tiles

- .1 Take precautions during installation to ensure tile edges are not chipped or otherwise damaged.
- .2 Minimize field cutting. Rectify cut tile edges of tile to match factory cut edge profile and colour.

Acoustical Tile Ceiling Systems

- .3 Install acoustical tiles to form horizontal and level ceiling with parts flush and joints butted tightly to hairline appearance.
- .4 Distribute variations in colour and texture of panels to obtain a uniform appearance.

3.4 Installation - Tolerances

- .1 Allowable tolerances: in accordance with ASTM C636/C636M-19.
- .2 Install suspension systems level to tolerance of 1:1200.
- .3 Install edge mouldings level to tolerance of 3 mm in 3660 mm (1/8" in 12'-0").

3.5 Field Quality Control

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

3.6 Adjusting and Cleaning

- .1 Replace uneven, defective or damaged materials and finishes, eliminate waves, remove soiled or stained areas.
- .2 Clean dirty and discoloured surfaces of acoustical units and suspension system according to manufacturer's recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Resilient base; RBF-1.

1.2 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 Samples:
 - .1 Selection samples:
 - .1 Submit manufacturer's range of pattern and colours available for *Consultant's* selection.
 - .2 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.
- .4 Test and evaluation reports:
 - .1 Submit moisture, alkalinity, and adhesive bond test results.
- .5 Manufacturer's instructions:
 - .1 Submit manufacturer's installation instructions for *Products* proposed for use in the work of this section.

1.3 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 10.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Provide 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*.

1.4 Quality Assurance

- .1 Qualifications:

Resilient Base and Accessories

.1 Installers:

- .1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified.

1.5 Site Conditions

- .1 Install materials of this section only when surfaces and air temperatures have been maintained between 21°C and 29.4°C for 7 days preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C after above period.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 10.
- .2 Extended warranty:
- .1 Labour, materials, and workmanship for work of this section.
- .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 General

- .1 Single source responsibility: Obtain each type of resilient *Product* from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the *Work*. Products installed as part of the work of this section shall be from same production run.

2.2 Resilient Base; RBF-1

- .1 Rubber base types:
- .1 Manufactured from thermoplastic rubber formulation meeting ASTM F1861-21, Type TP, Group 1 (Solid).
- .2 Rubber base; wall bases: Refer to Finish Schedule.

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.
- .3 Sealant: Mildew resistant sealant in accordance with Section 07 92 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that site conditions have been provided as requested and specified.
- .2 Substrates shall be firm, structurally sound, sufficiently porous, and dry.

Resilient Base and Accessories

- .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 Allow coiled material to lay flat for at least 24 hours at 18°C prior to installation, and maintain this temperature during installation.
- .2 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.
- .3 Fill gaps, voids, and cracks, and remove ridges, or other defects which will ghost or telegraph through finished product installation.
- .4 Expansion joints, isolation joints, and other movement joints in substrates shall not be filled with patching or levelling compound.
- .5 Sweep and vacuum clean substrates minimum 24 hours prior to alkalinity, moisture, and adhesion testing. Do not use sweeping compounds.
- .6 Notify *Consultant* of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.
- .7 Alkalinity and moisture and adhesion bond testing:
 - .1 Perform moisture and alkalinity tests and adhesive bond test in accordance with Field Quality Control paragraphs of Section 09 65 13.
 - .2 Proceed with installation only after substrates pass testing. Document tests performed and submit in writing to *Consultant*.
- .8 Do not install products until they are same temperature as space where they are to be installed.
- .9 Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. Do not use sweeping compounds.
- .10 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials.
- .11 Spray paints, permanent markers and other indelible ink markers shall not be used to write on the back of the resilient material or used to mark the substrate as they could bleed through and permanently stain the resilient material. If such contaminants are present on the substrate they shall be mechanically removed prior to the installation of the resilient material.

3.3 Installation of Resilient Base

- .1 Spread adhesive to ribbed surface (back) of wall base with a 3 mm (1/8") square-notched trowel; allow slight set-up, then bring base into contact with substrate. Ensure full adhesion of base to substrate. Adhesive should cover 80% of back surface. Leave a 6 mm (1/4") uncovered space at the top of the wall base to prevent the adhesive from oozing onto the wall above the base when installed.
- .2 Position wall base on wall surface and roll with hand roller. Always roll back to starting point to prevent stretching the wall base.
- .3 Set base to ensure installation over finished flooring material is free of gaps.
- .4 Install base in longest lengths possible, minimum 2440 mm (8'). Adhere toe of base to substrate, and ensure edge of toe is straight.
- .5 Scribe and fit to door frames and other obstructions.
- .6 Joints shall be tightly fitted, straight and vertical, and not less than 610 mm (24") from corners.
- .7 Provide joints in base over substrate control joints.
- .8 Field-made inside corners:
 - .1 Install wall base to terminate into the corner with a mitre cut.
 - .2 Position another piece of wall base on opposing wall, without adhesive, approximately 25 mm (1") from the installed piece.
 - .3 Utilizing the dividers, place the hooked end at the top of the installed piece and the pointer end on the top of the uninstalled piece. Carefully, move the dividers downward in a straight vertical motion, allowing the hooked end of the dividers to follow the profile of the installed piece. At the same time, place adequate pressure on the pointer end to transfer and/or scribe the profile onto the surface of the uninstalled piece.
 - .4 Use a utility knife to cut the pattern on the uninstalled wall base, apply adhesive, and position the trimmed section into place.
- .9 Field-made outside corners:
 - .1 Install wall base to terminate into the corner with a mitre cut.
 - .2 Stop application of adhesive to wall base approximately 450 mm (18") from the outside corner of the wall.
 - .3 Position the wall base at the corner and pencil line the back of the wall base where the bend is desired.
 - .4 Lay the wall base on the floor with the back up. Utilizing a top-set or pull-type gouge tool, make a shallow notch along the pencil line.
 - .5 Notch depth should not exceed one-quarter the total thickness of the wall base.
 - .6 Reposition the wall base corner on the wall. The corner of the wall should fit snugly into the notched recess on the back of the wall base.
 - .7 Apply adhesive and roll firmly into place.

Resilient Base and Accessories

3.4 Installation Tolerances

- .1 Resilient base: Install straight and level to variation of 3 mm (1/8") over 3 m (10'-0").

3.5 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Moisture and alkalinity:
 - .1 Test for moisture and alkalinity in accordance with product manufacturer's written requirements.
 - .2 Adhesion bond test:
 - .1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.
 - .2 Adhesions tests shall be completed in accordance with product manufacturer's written requirements.
 - .2 Manufacturer's field review to be in accordance with Section 01 45 00.

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

Vinyl Sheet Flooring

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Luxury vinyl sheet flooring; LVT-1.

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 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 vinyl sheet flooring, minimum 150 mm (6") x 150 mm (6") of each different colour and pattern of vinyl sheet flooring.
 - .2 Submit sample of heat-welding bead, minimum 150 mm (6") length of each colour.
 - .3 Submit seam samples for each vinyl 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.

1.3 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 10.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Submit width of material x 2% of each colour in full running length, pattern and type flooring material required for this project for maintenance use.

Vinyl Sheet Flooring

- .2 Maintenance materials to be same production run as installed materials.
- .3 Suitably package for protection and storage, each identified with name of manufacturer and flooring material.
- .4 Tag and store where directed by *Owner*.

1.4 Quality Assurance

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

1.5 Site Conditions

- .1 Install materials of this section only when surfaces and air temperatures have been maintained between 18.4°C and 29.4°C for 48 hours preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C after above period. Relative humidity shall be 50 +/- 10%.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 10.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) of 0.42 or greater in accordance with ANSI A326.3.
- .2 Vinyl sheet flooring shall not:
 - .1 Become stained or discoloured due to slab markings.
 - .2 Delaminate from substrates.
 - .3 Have welded seams which separate.

2.2 General

- .1 Single source responsibility: Obtain each *Product* from a single source with resources to provide products of consistent quality in appearance and physical properties, same production run. Products installed as part of the work of this section shall be from same production run.

2.3 Luxury Vinyl Sheet Flooring

- .1 Luxury vinyl sheet flooring: Refer to Finish Schedule.

Vinyl Sheet Flooring

2.4 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 manufacturer's full colour range.
- .2 Primer/adhesives:
 - .1 Types 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-24 or ASTM C472.
 - .3 Gypsum based compounds are not acceptable.
 - .4 Acceptable manufacturers:
 - .1 Ardex.
 - .2 Mapei.
 - .3 Substitutions permitted with approval by *Consultant*.
 - .5 Acceptable *Product*: type as recommended by flooring manufacturer.
- .4 Cleaning solution:
 - .1 Acceptable *Products*: type as recommended by flooring manufacturer.
- .5 Resilient base: in accordance with Section 09 65 13.
- .6 Floor transition strips:
 - .1 Resilient transition trims:
 - .1 Tapered vinyl type as manufactured by Tarkett 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*:
 - .1 Tarkett 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.
- .7 Sealant: Mildew resistant sealant in accordance with Section 07 92 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that site conditions have been provided as requested and specified.

Vinyl Sheet Flooring

- .2 Verify that substrates have been provided as specified without holes, protrusions, cracks greater than 1.6 mm (0.06") wide, unfilled control joints, depressions greater than 3 mm (1/8") deep, or other major defects.
- .3 Substrates shall be firm, structurally sound, sufficiently porous, and dry.
- .4 Examine substrate to ensure clean lines, correct level and freedom from cracks, ridges, dusting, scaling and carbonation.
- .5 Examine floors in advance of application of flooring to ensure that floors are protected against entry of water and moisture. 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 F710-22.
- .2 Allow products to acclimatize in installation area for a minimum 24 hour prior to installation.
- .3 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.
- .4 Concrete substrates that are loose, sandy, scaly, or have a white powdery surface are not acceptable. Substrates shall be mechanically prepared.
- .5 Flooring substrates shall be smooth and level within a tolerance of 3 mm (1/8") in a 3 m (10'-0") radius.
- .6 Fill surface cracks, holes, score marks, depressions, and grooves, and repair surface spalls with Portland cement patching or levelling compound.
- .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.

Vinyl Sheet Flooring

- .13 Alkalinity, moisture, and adhesion bond testing:
 - .1 Test substrates in accordance with Field Quality Control paragraphs of Section 09 65 16 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.
 - .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.

Vinyl Sheet Flooring

- .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 Install drain clamping rings.
- .6 As installation progresses, roll flooring with 45 kg (100 lb) three-section roller to ensure full adhesion, remove adhesive ridges, and entrapped air.
- .7 Where cove base is not required, seal joint at wall with manufacturer's approved sealant.
- .8 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.
- .9 Obtain 100% adhesive coverage to flooring backing.

Vinyl Sheet Flooring

- .10 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.
- .11 Heat-welded seams:
 - .1 Weld seams in accordance with ASTM F1516-13(2018).
 - .2 Wait minimum of 24 hours after flooring installation before grooving and heat welding seams.
 - .3 Prepare, weld, and trim seams to produce flat surfaces flush with adjoining floor covering surfaces.
 - .4 Rout joints to approximately 2/3 of the thickness of the material and use welding bead to permanently fuse sections into a seamless floor covering. Groove shall be between 3 mm (0.118") and 3.5 mm (0.138") wide.
 - .5 Using a weld plate and skiving knife to make first cut and allow weld rod to fully cure to room temperature.
 - .6 Using a skiving knife only, finish the trimming of the remainder of the weld. The finish should be smooth and on the same level as the flooring.
 - .7 Trimming of welded joint while warm is not permitted unless final trimming is performed after weld has cooled to flooring temperature. Excess weld shall be removed using a heated standard putty knife.
 - .8 Roll the seam area with 45 kg (100 lb) three-section roller.
 - .9 Maximum variation of welds from plane or from straight: 6 mm (1/4") in 3 m (10 ft) length using a 3 m (10 ft) straight edge.
- .12 Flooring installation shall not show telegraphing of substrate. Flooring installation shall be homogenous free of substrate lines, pockets, bumps and unevenness.

3.4 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 vinyl 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.
- .9 Mitre corners.

Vinyl Sheet Flooring

3.5 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Moisture and alkalinity:
 - .1 Test for moisture vapour transmission in accordance with ASTM F710-22 and ASTM F1869-23 or ASTM F2170-19a in accordance with manufacturer's written flooring installation requirements. Results must not exceed 170 $\mu\text{g}/\text{m}^2$ (3 lb per 1,000 ft^2) in 24 hours when tested to ASTM F1869-23, or exceed 75% when tested to ASTM F2170-19a.
 - .2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-22.
 - .3 For each test type: Conduct 3 tests for flooring applications up to 93 m^2 (1000 ft^2) in area, and 1 additional test for each additional 93 m^2 (1000 ft^2) 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 Manufacturer's field review.

3.6 Adjusting and Cleaning

- .1 Remove excess adhesive from surfaces of the sheet flooring and base 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.

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3.8 Maintenance

- .1 Perform initial maintenance in accordance with 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.
 - .2 Repainting of interior surfaces.
- .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 Exterior concrete.
 - .5 Stainless steel, weathering steel, copper, bronze, chromium plate, nickel, anodized or lacquered or mill finished aluminum, Monel metal.
 - .6 Insulation, glass, plastic, brick, stone.
 - .7 Metallic and mastic insulation finishes.
 - .8 Abrasive material finishes on floors, stair treads, stair nosing and landings.
 - .9 Insulated electric cables.
 - .10 Machined parts of machinery and equipment.
 - .11 Concealed surfaces.
 - .12 Manufactured finish materials.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting.
 - .1 Agenda shall include review of preparation requirements for surfaces to be repainted, including clear identification of responsibility for preparation of DSD-4 surfaces. *Contractor* shall be solely responsible for determining which *Subcontractor* shall prepare of each DSD-4 surface.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:

Painting

- .1 Submit manufacturer's *Product* data sheets and list of *Products* proposed for use in the work of this section as identified in 'Approved Product List' section of the MPI (Master Painters Institute) Architectural Painting Specification Manual and the MPI Maintenance Repainting Specification Manual (MPI Repainting Manual), as applicable. Correlate *Products* to Schedule furnished by *Consultant*.
- .3 Samples:
 - .1 Samples for initial paint colour and finish selection:
 - .1 Submit manufacturer's colour charts showing full range of colours available, including light and deep dark tones, for each type of finish material indicated for colour selection by *Consultant*.
 - .2 *Consultant* shall have complete freedom in choice of colours in compiling colour schedule and will not necessarily select colours from standard colour charts of manufacturer of *Products* specified.
 - .3 Submit 3 drawdowns of each selected colour for review by *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*.
 - .3 Resubmit as required until colours and gloss value are approved.
- .4 MPI (Master Painters Institute) Manual:
 - .1 Provide and maintain 1 copy of MPI Manual, latest edition, at site office for reference.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 10.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Provide 2 sealed containers, each of 4 litres (1 gallon) capacity of each paint product in each colour used in the *Work* for *Owner's* maintenance use. Containers shall be new, clearly labelled with manufacturer's name, type of paint, colour and colour number. Store at *Place of the Work* where directed by *Owner*.

1.5 Quality Assurance

- .1 Qualifications
 - .1 Manufacturers:

Painting

- .1 Paint manufacturers and *Products* used shall be as listed under the Approved Product List section of the MPI Painting Manual.
- .2 Installers / applicators / erectors:
 - .1 Applicators: Shall have minimum 5 years proven satisfactory painting experience of projects of similar size and class subject to *Consultant's* approval.
 - .2 Only qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency" shall be engaged in painting work. Apprentices shall work under the direct supervision of a qualified journeyman in accordance with trade regulations.

1.6 Product Handling

- .1 Product handling shall be in accordance with Section 01 61 00 as supplemented by the requirements of Section 09 91 00.
- .2 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.
- .3 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.
- .4 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 Site 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 and exterior work, unless suitable weatherproof covering and sufficient heating and ventilation facilities are in place in accordance with MPI Manual.
- .3 Perform no painting work when relative humidity is above 85% or when dew point is less than 3°C (5°F) variance between air/surface temperature.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 10.
- .2 Extended warranties:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

Painting

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Except where more stringent requirements are specified, the following reference standard shall govern the work of this section:
 - .1 Master Painters Institute (MPI) Architectural Painting Specification Manual (MPI Manual) and the MPI Maintenance Repainting Specification Manual (MPI Repainting Manual), as applicable, including Identifiers, Evaluation, Systems, Preparation and Approved Product List, latest edition, and referenced herein as the MPI Manual, as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
- .2 Materials, preparation and workmanship shall conform to requirements of latest edition of Architectural Painting Specification Manual by the Master Painters Institute (MPI) (hereafter referred to as the MPI Painting Manual) as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
- .3 Painting systems:
 - .1 Shall remain free from failure due to causes including: material failure; surface preparation less than that specified; and paint film thickness less than that specified, or when not specified, less than that coverage recommended by manufacturer.
 - .2 Presence of any of following shall constitute failure: visible corrosion; film peeling, blistering, checking, scaling, embrittling or general film disintegration; and poor adhesion as determined by tape "peel-off" test procedures.

2.2 Materials

- .1 *Products* listed in MPI Manual shall be used in the *Work*, unless specified otherwise.
- .2 Paint and materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, and the like) shall be in accordance with the MPI Manual "Approved Product" listing and shall be from a single manufacturer for each system used.
- .3 Other paint materials, such as linseed oil, shellac, and the like, shall be highest quality *Products* of an approved manufacturer listed in the MPI Manual and shall be compatible with other coating materials as required.
- .4 Paint materials shall have good flowing and brushing properties and shall dry or cure free of blemishes or sags.
- .5 Where required, paints and coatings shall meet flame spread and smoke developed ratings designated by building code requirements and/or authorities having jurisdiction.
- .6 Paints and coatings materials used within the weatherproofing system shall not exceed the VOC content limits of the following criteria.
 - .1 Interior paints and coatings: to following Green Seal GS-11 VOC limits:
 - .1 Flat coating type: 50 gm/L.
 - .2 Non-flat coating type: 150 gm/L.
 - .2 Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: Green Seal Standard GC-03, Anti-Corrosive Paints, maximum 250 gm/L.

Painting

- .3 Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements: South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings.

2.3 Equipment

- .1 Painting and coating equipment in accordance with written requirements of MPI Manual.

2.4 Mixing and Tinting

- .1 Unless otherwise specified, paints shall be ready-mixed. Re-mix prior to application to ensure colour and gloss uniformity.
- .2 Paste, powder or catalysed paint mixes shall be mixed in accordance with manufacturer's written requirements.
- .3 Perform colour tinting operations prior to delivery of paint to *Place of the Work*.
- .4 Where thinner is used, addition shall not exceed paint manufacturer's recommendations.

2.5 Colours and Gloss Levels

- .1 Paint colours and gloss levels shall be as selected by the *Consultant*. Locations as indicated or scheduled.
- .2 Colour and gloss schedule: in accordance with Finish Schedule.
- .3 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI values:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat finish	0 to 5	10 maximum
G2	Velvet finish	0 to 10	10 to 35
G3	Eggshell finish	10 to 25	10 to 35
G4	Satin finish	20 to 35	35 minimum
G5	Semi-gloss finish	35 to 70	
G6	Gloss finish	70 to 85	
G7	High-Gloss finish	> 85	

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that specified site conditions exist before commencing the work of this section.
- .2 Prior to commencement of work of this section, examine surfaces scheduled to be painted.
 - .1 For surfaces to be repainted, the degree of surface deterioration (DSD) shall be assessed using assessment criteria in accordance with the MPI Repainting Manual.
- .3 Check moisture content and alkalinity of surfaces to be painted in accordance with Field Quality Control paragraphs of Section 09 91 00.

Painting

- .4 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.
- .5 Report in writing any condition adversely affecting work of this section.
- .6 Proceed with work only when surfaces and conditions are satisfactory. Remove dust, grease, rust, scale and extraneous matter, tool and machine marks and insects from surfaces which could be detrimental to a satisfactory and acceptable finish.

3.2 Preparation

- .1 Comply with manufacturer's written requirements and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- .2 Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - .1 After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- .3 Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, mildew, grease, and incompatible paints, encapsulants, and other deleterious materials.
- .4 Paint surfaces when moisture content or alkalinity of surfaces to be painted comply with Field Quality Control paragraphs in Section 09 91 00.
- .5 Shop-primed steel substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- .6 ZF75 and ZF120 galvanized-metal substrates: Remove grease and oil residue from galvanized sheet metal by methods to produce clean surfaces that promote adhesion of subsequently applied paints.
- .7 Z275 galvanized-metal substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- .8 Substrates to be repainted:
 - .1 Prepare surfaces for repainting in accordance with MPI Repainting Manual requirements.

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 finish requirements based on Grade specified below in Section 09 91 00.

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- .3 Schedule application of paints and coatings after cleaning to prevent field conditions causing flash-rusting, rusting, weathering or water damage to substrate, or other contamination of the substrate. Comply with MPI manual, MPI Repainting Manual, and manufacturer's written requirements, the most stringent of which shall govern.
- .4 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer's recommendations.
- .5 Tint each coat of paint progressively lighter to enable confirmation of number of coats.
- .6 Unless otherwise approved by *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) and exposed/ visible in complete work including interiors of cupboards and closets, tops of doors, trim, and the like, whether in sight line or not, including behind surface mounted fixtures and heating units.
- .11 *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*.
- .12 Access doors, prime coated butts and other prime painted hardware, registers, radiators and covers, exposed piping and electrical panels shall be painted to match adjacent surfaces in terms of colour, texture and sheen, unless otherwise indicated.

3.4 Mechanical and Electrical Items

- .1 Finish paint primed mechanical and electrical items with 2 coats of paint. Include for the following list unless otherwise indicated:
 - .1 Convectors.
 - .2 Conduit.
 - .3 Grilles.
 - .4 Radiators, including perimeter wall panels/enclosures.
- .2 Prime and paint exposed insulated and bare pipes. Prime and paint exposed conduits and electrical raceways, fittings, outlet boxes, junction boxes, pull boxes and similar items. Use heat resistant epoxy paint on pipes and surfaces where operating surface temperature exceeds 65°C.
- .3 Coordinate the painting of pipes, and coverings with mechanical contractor applying colour banding, flow arrows and pipe identification after the painting of pipes and coverings.
- .4 Paint work to match adjacent walls and ceilings unless directed otherwise.

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- .5 Paint interior surfaces of air ducts and pipe trenches including heating pipes and elements that are visible through grilles and louvres with one coat of flat metal paint to limit of sight-line. Paint to be black or white as directed by *Consultant*.
- .6 Paint and finish wall surfaces behind convectors. Walls to be finished prior to installation of convector covers. Touch up walls after covers are installed as necessary to make good installation damage.

3.5 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Paint and Coating Quality Assurance Inspections:
 - .1 Field quality control shall be in accordance with Section 01 45 00.
 - .2 Moisture and alkalinity testing:
 - .1 Check moisture content of surfaces to be painted using properly calibrated electronic moisture meter approved by paint manufacturer and *Consultant*, or other approved method. Maximum moisture contents shall be in accordance with manufacturer's recommendations and as follows:
 - .1 Concrete and concrete masonry (clay and concrete brick/block): Maximum 12%.
 - .2 Gypsum board and plaster: Maximum 12%.
 - .3 Wood: Maximum 15%.
 - .2 Conduct moisture tests on concrete floors using cover patch test method.
 - .3 Test concrete, masonry and plaster surfaces for alkalinity.
 - .3 Painted surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the *Consultant*:
 - .1 Brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
 - .2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
 - .3 Damage due to touching before paint is sufficiently dry or any other contributory cause.
 - .4 Damage due to application on moist surfaces or caused by inadequate protection from weather.
 - .5 Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).
 - .4 Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces to the *Consultant*:
 - .1 Visible defects are evident on vertical and horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm (39").

Painting

- .2 Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
- .3 When final coat on any surface exhibits a lack of uniformity of colour, sheen, texture, and hiding across full surface area.
- .5 Painted surfaces rejected by the *Consultant* shall be made good at the expense of the *Subcontractor*. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.
- .6 Painting *Subcontractor* shall obtain from *Contractor* written confirmation of specific surface preparation procedures and primers used for fabricated steel items from the fabricator/*Supplier* to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work.

3.6 Adjusting and Cleaning

- .1 Promptly as work proceeds and on completion of *Work*, remove paint where spilled, splashed or spattered during the progress of the *Work*. Keep the premises free from unnecessary accumulation of tools, equipment, surplus materials and debris; at the conclusion of the work leave the premises clean.

3.7 Interior Paint Systems

- .1 System references listed are based on MPI Manual and are Premium Grade, Low VOC (Green Seal GS-11), unless otherwise indicated:
 - .1 Galvanized metal: (doors, frames, railings, misc. steel, pipes, overhead decking, ducts, etc.)
 - .1 INT 5.3M High performance architectural latex (over water based galvanized primer).
 - .2 Dressed lumber: (including wood trim, casings, mouldings, etc.)
 - .1 INT 6.3A High performance architectural latex (over latex wood primer).
 - .3 Plaster and gypsum board: (gypsum wallboard, drywall and textured finishes)
 - .1 INT 9.2B High performance architectural latex finish (over latex primer/sealer):
 - .1 Use high-hide primer sealer type at glass mat finished gypsum board.

3.8 Interior Repaint Systems

- .1 System references listed are based on MPI Repainting Manual and are Budget Grade, Low VOC (Green Seal GS-11), unless otherwise indicated:
 - .1 Concrete masonry unit assemblies (smooth and split face block and brick):
 - .1 RIN 4.2K High performance architectural latex finish.
 - .2 Galvanized metal: (doors, frames, etc.)
 - .1 RIN 5.3J High performance architectural latex (do not use flat finish on doors and door frames), gloss level G5.

Painting

.3 Plaster and gypsum board: (gypsum wallboard, drywall and textured finishes)

.1 RIN 9.2B High performance architectural latex finish:

END OF SECTION

1 General

1.01 Section Includes

- .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.

1.02 References

- .1 Division 00 and Division 01 apply to and are a part of each Mechanical Division:
 - .1 Division 20 – Common Mechanical Requirements;
 - .2 Division 21 – Fire Suppression;
 - .3 Division 22 – Plumbing;
 - .4 Division 23 – Heating, Ventilating, and Air Conditioning;
 - .5 Division 25 – Integrated Automation.
- .2 The provisions of this Section also apply to the following sections:
 - .1 Section 08 31 00 – Access Doors and Panels.

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 Submit any other submittals specified in this Section or other Sections of Mechanical Divisions.

1.04 Maintenance Material Submittals

- .1 As specified in Part 2 of this Section, submit a spare filter of each size of Ducted Fan Coil.

2 Products

2.01 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.

2.02 Access Doors

- .1 Refer to Section 08 31 00.
- .2 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.
- .3 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.
- .4 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.
- .5 Lay-in type tiles, properly marked, may serve as access panels. Coordinate marking of ceiling tiles with the 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.
- .6 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.
- .7 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.
- .8 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.
- .9 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.
- .10 Manufacturers:
 - .1 SMS.
 - .2 Bauco.
 - .3 Acudor.

2.03 Flexible Piping 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.
- .2 Manufacturers:

- .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.

3.03 Duct Openings

- .1 Duct openings, air inlet and outlet openings, and similar openings will be provided in new work, masonry, drywall and other building surfaces by trade responsible for particular construction in which opening is required.
- .2 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.

3.04 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.

3.05 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 the 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.

3.06 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.

3.07 Finish Painting of Mechanical Work

- .1 Touch-up paint damaged factory applied finishes on mechanical work products.

3.08 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 the 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, Condensate 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 Refrigerant Piping
 - .1 Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 29 of ASHRAE Handbook – Fundamentals (2021).
- .9 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 tighten leaks found during tests while piping is under pressure. 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.

3.09 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 the 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 Consultant.
- .6 Where existing isolation valves do not hold, pipe freezing shall be used to connect new piping to existing piping.

3.10 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 the 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 Firestop and seal openings in fire rated construction. Do not leave openings open overnight unless approved by Owner and Consultant.

3.11 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;

3.12 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.

3.13 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.

3.14 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.

3.15 Installation of Flexible Connectors

- .1 Provide flexible connectors in piping connections to vibration isolated equipment.

3.16 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.

3.17 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 the Consultant that equipment/system installation is complete and in accordance with equipment/system manufacturer's instructions.

3.18 System Startup

- .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 the Consultant for review, and incorporate any comments made by the 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 the Consultant complete set of start-up documentation sheets signed by manufacturer/supplier and Contractor.
- .2 Provide labour and material to conduct the integrated systems testing of interconnected life safety systems in accordance with CAN/ULC-S1001-11, and provide written report for Consultant's review. Ensure all required trade contractors are present on site as directed by the Integrated Testing Coordinator during the CAN/ULC-S1001-11 functional testing. Refer to Section 01 91 26.13.

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 the Consultant who will issue a Site Instruction. If, in the opinion of the 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, except for the following which are to be handed over to Owner at site:
 - .1 Classroom Ceiling Fans
 - .2 Any other items indicated in other sections of the specifications and/or indicated on the drawings.

End of Section

1 General

1.01 Section Includes

- .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 Division 00 or Division 01, conditions of Division 00 or Division 01 to take precedence.
- .2 Be responsible for advising product vendors of requirements of this Section.

1.02 Related Requirements

- .1 Division 00 and Division 01 apply to and are a part of this Section.

1.03 Specifications Language and Style

- .1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to Contractor, unless stated otherwise.
- .2 Complete sentences by reading "shall", "Contractor shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.
- .3 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.
- .4 When used in the context of a Product, read the word "provide" to mean "supply and install to result in a complete installation ready for its intended use."

1.04 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 the 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 Division 20, Division 21, Division 22, Division 23, Division 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 Division 26, Division 27, Division 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.

1.05 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 the 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 the 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.

1.06 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.

1.07 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.

1.08 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 the 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 journeyperson tradesmen who perform only work that their certificates permit, or by apprentice tradesmen under direct on site supervision of experienced journeyperson tradesman. Journeyperson 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 the 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 the Consultant and submission of reports and certificates to the 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 the 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.

1.09 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.

1.10 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 Division 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.

1.11 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 the Consultant.

1.12 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 the 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.

1.13 Scheduling

- .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 the 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 the 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 the 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.

1.14 Coordination

- .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 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.

1.15 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 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 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 the 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 the 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 the 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 the 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 the 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 the 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 the Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equal" products is at sole discretion of the 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 the Consultant for review. Failure of submission of these documents to the 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 the 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 the Consultant at the Consultant's discretion, with any additional costs for such changes if accepted by Owner and reviewed with the 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.

1.16 Shop Drawings

- .1 At start-up meeting, review with the Consultant products to be included in shop drawing submission. Prepare and submit list of products to the Consultant for review.
- .2 Submit electronic copies of shop drawings unless otherwise directed by the Consultant. Coordinate exact requirements with the Consultant.

- .3 Submit for review, drawings showing detail design, construction, and performance of equipment and materials as requested in Specification. Submit shop drawings to the 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 the 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.

1.17 Equipment Loads

- .1 Supply equipment loads (self-weight, operating weight, housekeeping pad, inertia pads, etc.) to the 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 the 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 the Consultant prior to construction.

1.18 Openings

- .1 Supply opening sizes and locations to the 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 the Consultant. Show required openings on a copy of structural drawings. Identify exact locations, elevations, and size of proposed openings and submit to the 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 the Consultant, do not leave any openings unprotected and unfinished overnight.

1.19 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 the 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 the Consultant.

1.20 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 the 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 Division 01, allowable maximum percentages for overhead and profit are to be 7% and 5% respectively.
- .4 Unless otherwise specified in Division 00 or Division 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 the latest edition of Allpriser price guide, less 20%;
 - .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 journeyperson 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 the Consultant.

1.21 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.

1.22 Notice for Required Field Reviews

- .1 Whenever there is a requirement for the Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect 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 the 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 the 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.

1.23 Preliminary Testing

- .1 When directed by the Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with 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.

1.24 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.

1.25 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.

1.26 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.

1.27 Record Documentation

- .1 Drawings for this project have been prepared on a CAD system using AutoCAD software of release version reviewed with the Consultant. For purpose of producing record "as built" drawings, copies of Contract Drawings can be obtained from the 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 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;
 - .4 location of piping system air vents;
 - .5 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 the Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of the 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 the 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 the Consultant.
- .6 Unless otherwise noted in Division 00 or Division 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 the Consultant.

- .7 For projects with phased turnover of project (refer to Division 01), review with the 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 Operation and Maintenance Data

- .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 the 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 Division 00 and Division 01, warrant mechanical work to be in accordance with Contract Documents and free from defects for a period of 1 year 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 the 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 Provide training to Owner as specified in trade Sections on the operation and maintenance procedures of mechanical systems and equipment.
- .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 the 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 the 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 the 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 the 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 the Consultant;
- .8 as-built and record drawings have been completed and submitted to and reviewed with the 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

3.01 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.

End of Section

1 General

1.01 Section Includes

- .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 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.

1.03 Closeout Submittals

- .1 Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

1.04 Quality Assurance

- .1 Applicator is to have a minimum of 3 years of successful experience on projects of similar size and complexity, and applicator's qualifications are to be reviewed by the Consultant.
- .2 Comply with firestopping and smoke seal product manufacturer's recommendations regarding suitable environment conditions for product installation.

2 Products

2.01 Pipe Sleeves

- .1 Galvanized Steel or Cast Iron Pipe – Schedule 40 mild galvanized steel, or Class 4000 cast iron.

2.02 Firestopping and Smoke Seal Materials

- .1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN/ULC-S115 and CAN/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 Manufacturers:
 - .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.

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 Manufacturers:
 - .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.

3 Execution

3.01 Installation of Pipe Sleeves

- .1 Where pipes pass through concrete and/or masonry surfaces provide pipe sleeves as follows:
 - .1 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 roof slab;
- .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.

3.02 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.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for:
 - .1 pressure gauges and thermometers;

2 Products

2.01 Pressure Gauges and Thermometers

- .1 Pressure gauges as follows:
 - .1 adjustable, glycerine filled, 100 mm or 115 mm (4" or 4-½") diameter and each accurate to within 1% of scale range;
 - .2 type 304 stainless steel case with relief valve and polished stainless steel bayonet;
 - .3 stainless steel rotary movement with stainless steel bushings and socket;
 - .4 clear acrylic window;
 - .5 dual scale white dial with a scale range such that working pressure of system is at approximate mid-point of scale;
 - .6 black pointer.
- .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 each pressure gauge for steam piping or steam equipment is to be equipped with a steel coil syphon;
 - .4 pressure gauges in fire protection piping must be ULC listed and labelled;
- .3 Thermometers as follows:
 - .1 round, 125 mm (5") diameter, adjustable (90°) angle bimetal dial type thermometers, each accurate to within 1% of full scale;
 - .2 hermetically sealed stainless steel case with stainless steel ring;
 - .3 dampened bimetal coil;
 - .4 calibration adjustment screw;
 - .5 white aluminum dual scale dial with black and blue markings and a range such that working temperature of system is approximate mid-point of the scale;
 - .6 black aluminum pointer;
 - .7 double strength glass window;

- .8 12 mm (½") NPT connection with 6.4 mm (¼") diameter stainless steel stem;
- .9 suitable thermowell.
- .4 Manufacturers:
 - .1 H.O. Trerice Co.;
 - .2 Weiss Instruments;
 - .3 Ashcroft.

3 Execution

3.01 Installation

- .1 Provide pressure gauges in following locations where applicable:
 - .1 in supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.;
 - .2 in piping at each side of a pressure reducing valve;
 - .3 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.

End of Section

1 General

1.01 Section Includes

- .1 The work covered under this section consists of the furnishing of all necessary labour, supervision, materials, equipment, and services to completely execute the pipe hanger and supports as described in this specification.
 - .1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, provide for expansion and contraction and to accommodate insulation; provide insulation protection saddles.
 - .2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
 - .3 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
 - .4 Fasten hangers and supports to building structure.
 - .5 Provide and set sleeves required for equipment, including openings required for placing equipment.

1.02 References

- .1 Pipe supports shall meet the requirements of ANSI/ASME B31.1-1995, Power piping.
- .2 Automatic sprinkler pipe supports shall meet the requirements of NFPA 13-1996, Standard for the Installation of Sprinkler Systems.
- .3 Duct hangers shall follow the recommendations of the SMACNA Duct Manuals.

2 Products

2.01 Prohibited Materials

- .1 Use of existing piping or equipment for hanger supports is not permitted.
- .2 Use of perforated band iron, wire or chain as hangers is not permitted.

2.02 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 or metal strapping 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 or metal strapping are not permitted.
- .6 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;
- .7 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 piping on new roofs – Lexcor "Flash-Tite" or Thaler Roofing Specialties Products Inc. "MERS" Series insulated aluminum support risers with diameter, height, securement method and flashing to suit the application, channel type aluminum cross members, and galvanized steel pipe hangers and supports conforming to MSS SP-58, complete with all required accessories;
 - .5 for glass drain and vent piping – special padded hangers supplied by pipe supplier;
 - .6 for plastic piping – generally as specified above but in accordance with pipe manufacturer's recommendations;
 - .7 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;

- .8 for bare horizontal copper piping – generally as above but factory vinyl coated to prevent direct copper/steel contact;
- .9 for bare copper vertical piping – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate pipe from clamp;
- .10 insulation protection shields to and including 40 mm (1-½") dia. – MSS Type 40 galvanized steel shields with ribs to keep shield centred on hanger.
- .8 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.
- .9 Manufacturers:
 - .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.

3 Execution

3.01 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 the Consultant.

3.02 Installation of Pipe Hangers and Supports

- .1 Provide required pipe hangers and supports.
- .2 Provide any additional structural steel channels, angles, inserts, beam clamps 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 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 (1-½") dia. are to be adjustable clevis type.
- .5 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 copper and steel pipe – hang or support at spacing in accordance with following schedule:

Pipe dia.	Max. Spacing Steel	Max. Spacing Copper
to 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1-½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2-½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3-½")	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')	

- .4 flexible grooved pipe/coupling joint piping – as above but with not less than one hanger or support between joints;
- .6 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.
- .7 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.
- .8 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.
- .9 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.
- .10 Support piping on the roof as follows:
 - .1 On existing roof – support piping on roof as per typical detail indicated on drawings;
- .11 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.
- .12 For insulated horizontal piping less than or equal to 40 mm (1-½") diameter, provide galvanized steel insulation protection shields between insulation and hanger or support. Install shields immediately after pipe is insulated.
- .13 Do not support piping from steel deck without written consent from Consultant.

3.03 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 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 OHSA requirements and adequately sized, braced, and anchored.

- .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 (1-1/4") 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 (1-1/2") 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 (6-1/2") wide and factory made by grating manufacturer, handrails, and suitable anchoring and support.
- .4 See attached structural letter for support of condensers.

End of Section

1 General

1.01 Section Includes

- .1 Heat tracing for plumbing systems, including condensate drains.
- .2 Heat tracing for HVAC systems.

1.02 Submittals

- .1 Submit heating cable and control shop drawings/product data sheets, complete with control schematics.

1.03 Closeout Submittals

- .1 Submit a start-up certification letter from cable supplier as specified in Part 3 of this section.
- .2 Submit certified cable megger test reports as specified in Part 3 of this section.

2 Products

2.01 Manufacturers

- .1 nVent Thermal Management, LLC (RAYCHEM)
- .2 Dimplex/Chromalox Inc.;
- .3 Tyco Thermal Controls/Pyrotenax.

2.02 Pipe Freeze Protection Heating Cable

- .1 Raychem Canada Ltd. "XL-Trace-CR" CSA certified and UL Listed, self-regulating piping freeze protection cable sets as specified and/or scheduled on drawings, each set complete with:
 - .1 Required lengths of "XL-TRACE" self-regulating heating cable;
 - .2 Heating cable with fluoropolymer outer jacket
 - .3 Power connection with end seal per circuit;
 - .4 Tee connections with end seals as required for pipe branches;
 - .5 Splice connections as required;
 - .6 For heat tracing on metal pipe, GT-66 glass tape to secure cable on pipe, and "Electric Traced" adhesive labels to be secured to pipe insulation;
 - .7 For heat tracing on plastic pipe, AT-180 aluminum tape to secure cable on plastic pipe, and "Electric Traced" adhesive labels to be secured to pipe insulation;
 - .8 Pipe temperature sensing thermostat.
 - .9 Complete with integral ground fault protection.
 - .10 ProtoNode-RER-1.5K Multi-protocol device gateway for BACnet.
 - .11 C910-485 microprocessor-based, single-point commercial heating cable control system with integrated equipment ground-fault protection, BACnet gateway, dry contact alarm output, NEMA 4X fiber reinforced plastic enclosure, 120-277 V 30 A double pole relay.

2.03 De-Icing Heating Cable – Drain Pan Heater

- .1 Raychem Canada Ltd. "IceStop GM-1XT" CSA certified, parallel circuit construction, self-regulating cable consisting of 2 #16 gauge nickel coated, stranded copper bus wires embedded in a parallel self-regulating crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Complete with junction boxes for power connections and end seal terminations. Additional accessories as follows:
 - .1 expansion joint kits to permit cable to cross heated surface expansion joints;
 - .2 splice kits to permit splicing or repairing cable;
 - .3 Complete with integral ground fault protection.

3 Execution

3.01 Installation of Freeze Protection Heating Cable

- .1 Supply electric tracing cable sets to prevent piping from freezing.
- .2 Install cable sets and accessories as per manufacturer installation instructions. Clearly identify piping to be traced. Ensure piping has been pressure tested prior to cable installation and manufacturer's installation instructions are observed. Coordinate with electrical trade for final power connection to controller.
- .3 Mount heat tracing controller as indicated on drawings or within 2 m of start of heat tracing.
- .4 After cable installation but before application of piping insulation, megger test and commission cable in presence of the Consultant and in accordance with cable manufacturer's installation and operation manual. Replace any damaged or faulty cable, and when satisfactory results have been obtained, submit signed test reports to the Consultant.
- .5 When traced piping has been insulated, install "Electrically Traced" labels on opposite sides of pipe at 3 m (10 ft) intervals and in accordance with requirements specified in Section 20 05 00 – Common Work Results for Mechanical.
- .6 When cable installations are complete, check and test operation of each cable set with heater manufacturer's representative, make any required adjustments, and have cable manufacturer certify in writing that cable sets have been properly installed and operate as intended.

3.02 Installation of De-Icing Heating Cable – Drain Pan Heater

- .1 Supply electric heating cable to prevent ice and snow formation on condensate drain pan below each condenser.
- .2 Install cable sets and accessories as per manufacturer installation instructions. Clearly identify piping to be traced. Ensure piping has been pressure tested prior to cable installation and manufacturer's installation instructions are observed. Coordinate with electrical trade for final power connection to controller.
- .3 Install snow sensor and connect to snow controller with 24 V wiring in conduit in accordance with sensor manufacturer's instructions and wiring standard of electrical work. Test operation of sensor and controller in presence of cable manufacturer's representative and adjust as required.
- .4 After cable installation but before placement of covering surface material, megger test and commission cable in presence of the Consultant and in accordance with cable manufacturer's installation and

operation manual. Replace any damaged or faulty cable, and when satisfactory results have been obtained, submit signed test reports to the Consultant.

- .5 Carefully place an aluminium snow melting area caution sign flush with grade at each snow melting area, and coordinate placement with trade constructing finished surface.

3.03 Installation of Heat Tracing and De-Icing Cable Controller

- .1 Supply controllers as noted on the mechanical drawings and schedules.
- .2 Install electric heating cable, panels and controllers in accordance with drawings and manufacturer's installation and operation manuals.
- .3 Installer to be responsible for providing complete functional system, installed in accordance with applicable national and local requirements.
- .4 Coordinate with Div 25 for integration and configuration with BMS.

End of Section

1 General

1.01 Section Includes

- .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.

1.03 Closeout Submittals

- .1 Submit a letter from vibration isolation manufacturer to certify correct installation of products, as specified in Part 3 of this Section.

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 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 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 (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 Manufacturers:
 - .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 Manufacturers:
 - .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 Manufacturers:
 - .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 Manufacturers:
 - .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 Manufacturers:
 - .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 Manufacturers:
 - .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 Manufacturers:
 - .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 Manufacturers:

- .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 Manufacturers:

- .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 Manufacturers:

- .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 Manufacturers:

- .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 Manufacturers:
 - .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 (¼") movement before engaging and resisting wind loads in any lateral direction.
- .2 Manufacturers:
 - .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 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 into 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.
- .11 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 the Consultant.
- .12 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.

End of Section

1 General

1.01 Section Includes

- .1 Nameplates.
- .2 Tags.
- .3 Pipe Markers.

1.02 References

- .1 ASME A13.1 – Scheme for the Identification of Piping Systems.

1.03 Submittals

- .1 Section 01 33 00: Submittals.
- .2 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.
- .3 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- .4 Product Data: Provide manufacturers catalogue literature for each product required.
- .5 Samples: Submit two labels, tags samples to Consultant for approval.
- .6 Manufacturer's Installation Instructions: Indicate special procedures, and installation.

1.04 Closeout Submittals

- .1 Section 01 77 00: Project Closeout.
- .2 Record actual locations of tagged valves.

2 Products

2.01 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.:

VALVE V12 200 mm (8") CHILL. WATER NORMALLY OPEN

- .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.
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
heating water supply	yellow	HTG. WTR. SUPPLY
heating water return	yellow	HTG. WTR. RETURN
heating water drain	yellow	HTG. WTR. DRAIN
pumped condensate	yellow	PUMPED CONDENSATE
refrigerant suction	yellow	REFRIG. SUCTION
refrigerant liquid	yellow	REFRIG. LIQUID
refrigerant hot gas	yellow	REFRIG. HOT GAS

- .5 Colours for pipe identification legends and directional arrows are to be as follows:

Identification Colour	Legend and 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.

3 Execution

3.01 Preparation

- .1 Degrease and clean surfaces to receive adhesive for identification materials.

3.02 Installation

- .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

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.

1.04 Closeout Submittals

- .1 Submit a report by Agency after each site visit made by Agency during construction phase of this Project.
- .2 Submit a draft report, as specified in Part 3 of this Section.

- .3 Submit a final report, as specified in Part 3 of this Section.
- .4 Submit a testing and balancing warranty as specified in Part 3 of this Section.
- .5 Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.05 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. Agency is to have successfully completed testing, adjusting, and balancing of mechanical systems for a minimum of 5 projects similar to this Project within past 3 years, and is to be certified as an independent agency in required categories by one of following:
 - .1 AABC – Associated Air Balance Council;
 - .2 NEBB – National Environmental Balancing Bureau.
- .2 NBCTA certification in lieu of the above noted organizations is not permitted.
- .3 Testing, adjusting, and balancing of complete mechanical systems is to be performed over entire operating range of each system in accordance with one 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.

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 For air handler HRV-1, provide perform duct traverse air flow test for air flow through at supply duct, and air flow at return/exhaust duct.
- .3 Mechanical systems to be tested, adjusted, and balanced include:
 - .1 TAB of air handling systems is to include equipment and ductwork air temperatures, capacities, and flows.
 - .2 Following existing systems, revised as part of mechanical work are to be tested, adjusted, and balanced as for new systems:
 - .1 HRV-1 supply, exhaust/return air flows. Duct traverse is acceptable.

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 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 Temperature Control 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 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.

End of Section

1 General

1.01 Section Includes

- .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 Submit a product data sheet for each insulation system product.

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 CAN/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.
- .1 Manufacturers:
- .1 Armacell AP/Armaflex SS;
- .2 IK Insulation Group K-Flex "LS" Self-Seal Pipe Insulation.
- .3 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 CAN/ULC-S115 and CAN/ULC-S101 firestopping.
- .1 Manufacturers:
- .1 Roxul "Tecton 1200";
- .2 IIG (Johns Manville Inc.) MinWool-1200;
- .3 Paroc 1200.
- .4 Pre-moulded mineral fibre is to be rigid, sectional, sleeve type insulation to ASTM C547, with a factory applied vapour barrier jacket.
- .1 Manufacturers:
- .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.
- .5 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.
- .1 Manufacturers:
- .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.
- .6 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 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.

- .1 Manufacturers:
 - .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.

2.05 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.
 - .1 Manufacturers:
 - .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.
 - .1 Manufacturers:
 - .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 (1-½ lb/ft³) density, 40 mm (1-½") thick, with a factory applied vapour barrier facing.
 - .1 Manufacturers:
 - .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 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.
 - .1 Manufacturers:
 - .1 Armacell "AP/Armaflex SA";

.2 IK Insulation Group "K-Flex Duct Wrap", S2S.

- .5 Extruded polystyrene tapered insulation – equal to Soprema Sopra-ISO Tapered, closed cell polyisocyanurate foam core with organic facers reinforced with glass fibres, 172 kPa compressive strength as per ASTM D1621, 32 kg/m³ density, 50 mm minimum thickness, 2% slope. Thickness shall increase if width of duct work is larger than 1200 mm to maintain 2% slope.

2.06 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".

2.07 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.

2.08 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 CAN/ULC-S102, complete with installation and sealing accessories.
- .1 Manufacturers:

- .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 Stainless Steel Jacket – equal to ITW Insulation Systems Canada "Lock-on" 0.254 mm (0.010") thick type 304 embossed stainless steel jacket material to ASTM A240, factory cut to size and complete with moisture barrier and continuous modified Pittsburgh Z-Lock, butt straps with "Fabstraps" to cover end to end joints, and 2-piece pressed stainless steel fittings with weather locking edges.
- .5 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.
- .6 Heat resistant, trowel consistency thermal insulating and finishing cement to CAN/CGSB 51.12, and suitable for the application.
- .7 Foamed glass insulation protective coating is to be Pittsburgh Corning "PITTCOTE 300e" flexible acrylic latex weather barrier coating, white unless otherwise specified.
- .8 UV and moisture resistant flexible foam insulation with protective jacket equal to Armacell "ArmaFlex Shield".

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 manufactured expansion joints and flexible connections;
 - .8 acoustically lined ductwork and/or equipment;
 - .9 factory insulated flexible branch ductwork;
 - .10 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 Insulate, vapour seal, and finish restraints, braces, anchors, hanger rods, and similar hardware directly connected to "cold" piping and/or equipment, for a distance of 300 mm (12") clear of adjacent pipe or equipment finish, to match piping and/or equipment insulation.
- .7 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.
- .8 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.
- .9 Where existing insulation work is damaged as a result of mechanical work, repair damaged insulation work to Project work standards.
- .10 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.
- .11 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.
- .12 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.

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 hot water piping, less than 40 mm (1-½") dia. – 25 mm (1") thick;
 - .3 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;

- .4 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;
- .5 piping indicated to be traced with electric heating cable – minimum 50 mm (2") 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 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.
- .7 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 piping inside and outside building – 25 mm (1") thick.

3.04 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.

3.05 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").

3.06 Installation of Weather-Proof Jacketed Insulation

- .1 Install sectional weather-proof jacketed pipe insulation in strict accordance with manufacturer's instructions to produce a water-tight weather-proof installation. Insulate fittings with blanket type glass fibre insulation of a thickness and insulating value equal to the sectional insulation and secured in place with adhesive and wire. Jacket fittings with manufactured aluminium fitting covers sealed water-tight. Insulate following pipe with weather-proof jacketed insulation:
 - .1 Refrigerant piping outside building;
 - .2 Condensate drain outside building.

3.07 Ductwork Insulation Requirements – Mineral Fibre

- .1 Insulate following ductwork systems inside building and above ground with mineral fibre insulation of thickness indicated:
 - .1 Outdoor air and combustion 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 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;
 - .3 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.

3.08 Ductwork Insulation Requirements – Flexible Elastomeric

- .1 Insulate exposed exterior ductwork (except outdoor air intake ductwork) and associated plenums and/or casings outside building with minimum 75 mm (3") thick flexible elastomeric sheet insulation as required, applied in 2 minimum 40 mm (1 ½") 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 Provide Calcium Silicate insulation between ductwork and duct supports. Tightly butt flexible elastomeric insulation to Calcium Silicate insulation. Cover Calcium Silicate insulation with a continuous sheet of self-adhesive multilayer jacketing which overlaps 75 mm past the Calcium Silicate insulation to the adjacent flexible elastomeric insulation.
- .4 Provide extruded polystyrene tapered insulation between flexible elastomeric insulation and jacketing to allow for water runoff on all exterior duct work.
- .5 Apply coatings with a brush. Remove any splatter or excess coating from adjacent surfaces.

3.09 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 Unless otherwise shown or specified, jacket exposed mineral fibre insulation listed below with canvas jacket secured in place with a full covering coat of coloured lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent surfaces. Insulated services to receive coloured lagging adhesive are as follows:
 - .1 Domestic Cold Water Piping;
 - .2 Domestic Hot Water Piping;
 - .3 Heating Water Piping;
 - .4 Condensate Drain Piping;
 - .5 Indoor Ductwork;
- .3 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.
 - .1 Outdoor Condensate Drain Piping;
 - .2 Outdoor Refrigerant Piping;

End of Section

1 General

1.01 Section Includes

- .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 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.

1.03 Submittals

- .1 Submit to Commissioning Agent, at same time as submittal to the 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.

1.04 Closeout Submittals

- .1 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 the 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 the 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 the Consultant and Commissioning Agent during commissioning process within 15 calendar days of notification unless agreed otherwise with the Consultant, and when deficiencies have been corrected, notify the 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 air handling systems includes equipment, ductwork, ductwork specialties, controls, interlocks, and checking and validating air capacities and flows in accordance with TAB reports.
- .3 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.
- .4 Commissioning of BAS includes confirmation of proper operation of components, input/output points, hardware and software, and demonstration of system performing required procedures.
- .5 Commissioning of noise and vibration control equipment includes noise and vibration measurements to confirm proper operation of equipment.
- .6 Perform commissioning of following existing systems, revised as part of the Work, as for new systems:
 - .1 HRV-1 operation including Fire Alarm Shut-down

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, the 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 the 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 the 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 the 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 to regulatory authority for review and approval prior to submitting to the Consultant. Conform to following requirements:
 - .1 submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings;
 - .2 sprinklers shall be referred to on drawings and product submittals, and be specifically identified by the manufacturer's listed model or series designation. Trade names and other abbreviated listings are not allowed;
 - .3 submit copies of all calculations, including hydraulic calculations (as required), stamped and signed by same engineer who signs layout drawings, and a listing of all design data used in preparing the calculations, system layout and sizing, including occupancy-hazard design requirements;

1.02 Closeout Submittals

- .1 Submit a complete sprinkler system test certificate as specified in Part 3 of this Section.
- .2 Contractor's material test certificates are required upon completion of the sprinkler system installation, verification, and testing.

1.03 Spare Parts

- .1 Fill spare sprinkler head cabinet complete with spare heads.

1.04 Quality Assurance

- .1 Fire protection sprinkler system work is to be in accordance with following Codes and Standards:
 - .1 NFPA 13-2019, Standard for the Installation of Sprinkler Systems;
 - .2 ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless;
 - .3 ASTM A135, Standard Specification for Electric-Resistance-Welded Steel Pipe;
 - .4 ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service;
 - .5 ASTM A536, Standard Specification for Ductile Castings;
 - .6 ASTM A795, Standard Specification for Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use;
 - .7 ANSI/ASME B16.4, Grey Iron Threaded Fittings (Classes 125 and 250);
- .2 Fire protection sprinkler work is to be performed by a sprinkler company who is a member in good standing of the Canadian Automatic Sprinkler Association. Site personnel are to be licensed in jurisdiction of the work and under the continuous supervision of a foreman who is an experienced fire protection system installer and a journeyman pipe fitter licensed in jurisdiction of the work.
- .3 Check and verify dimensions and conditions at site and ensure work can be performed as indicated. Coordinate work with trades at site and accept responsibility for and cost of making adjustments to piping and/or spacing to avoid interference with other building components.

- .4 Verify working condition of existing sprinkler system equipment which has direct interface with project work and is to remain. Replace with new equipment where necessary.
- .5 System components must be ULC listed and labelled and FM approved.
- .6 All grooved couplings, and fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- .7 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.05 Design Requirements

- .1 Fire protection sprinkler work is to be designed in accordance with NFPA 13 and Provincial Standards, and, where required, local building and fire department requirements and standards of Owner's Insurer. If water supply flow and pressure test data is not available, conduct Municipal main water flow and pressure tests at nearest fire hydrant to obtain criteria to be used in system design. Include hydrant location and flow and pressure test data with system design calculations.
- .2 Include for a qualified mechanical professional engineer registered and licensed in the jurisdiction of the work to design the fire protection work. For requirements regarding Contractor retained engineers, refer to Section 20 05 10 – Mechanical Work General Instructions.
- .3 Sprinkler /System Occupancy – Hazard Design requirements: In accordance with NFPA 13 occupancy-hazard density requirements, unless otherwise specified.
- .4 Read these specifications in conjunction with notes on fire protection drawings.
- .5 Crossmain of base building's system shall be maintained without alteration. Otherwise apply and obtain a separate sprinklers permit.
- .6 All sprinkler piping shall be of non-combustible construction as per Ontario Building Code.

2 Products

2.01 Pipe, Fittings, and Joints

- .1 Pipe, fittings, and joints are to be as follows, with exceptions as specified in Part 3 of this Section:
 - .1 Schedule 40 Steel – Grooved Coupling Joints
 - .1 Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and mechanical fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N, 107H, and 107N QuickVic and 005 rigid coupling joints. Strap type outlet fittings such as Victaulic "Snap-Let" are not acceptable.
 - .2 Schedule 40 Steel – Screwed and Welded Joints
 - .1 Schedule 40 mild black carbon steel, ASTM A53, Grade B. Screwed piping complete with Class 125 cast iron screwed fittings to ANSI/ASME B16.4. Welded piping complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, long sweep pattern wherever possible.
 - .3 Schedule 10 Steel – Grooved Coupling Joints
 - .1 Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N, 107H, and 107N QuickVic and 005 rigid coupling joints.

- .4 Schedule 10 Steel – Screwed Joints
 - .1 Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with mill or site threaded ends, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.
- .5 "Lightwall" Steel – Grooved Coupling Joints
 - .1 Commercial quality. "Lightwall" rolled mild carbon steel pipe to ASTM A135, Grade A, complete with a galvanized exterior, grooved ends, and fittings and couplings equal to Victaulic "Fire Lock" grooved fittings and Victaulic Style 009N QuickVic or 005 rigid coupling joints.
- .6 "Lightwall" Steel – Screwed Joints
 - .1 Commercial quality, "Lightwall" rolled mild carbon steel pipe to ASTM A135, Grade A, ULC listed, mill or site threaded, complete with galvanized exterior, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.
- .7 Flexible Pipe – Equal to Victaulic "VicFlex"
 - .1 The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel 1" NPT Male threaded nipple for connection to branch-line piping, and a zinc plated steel reducer with a 1/2" or 3/4" NPT female thread for connection to the sprinkler head.
 - .2 Option: Victaulic FireLock IGS Groove Style 108 coupling for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head.
 - .3 The drop shall include a cULus/FM approved Series AH2 braided hose with a bend radius to 2" to allow for proper installation in confined spaces.
 - .4 The hose shall be listed for:
 - .1 (4) bends at 31" length;
 - .2 (5) bends at 36" length;
 - .3 (8) bends at 48" length;
 - .4 (10) bends at 60" length;
 - .5 (12) bends at 72" length.
 - .5 Union joints shall be provided for; ease of installation, prevention of hose torque stresses and on site changing of factory 5.75" straight reducing nipple in reduced spaces under obstructions (optional reducing nipples; 4.83" or 6.57" reducing 90 and 9" or 13" straight reducer x 1/2 or 3/4" outlet) All VicFlex assemblies and related accessories to be installed as per the guidelines and listings in Victaulic submittal 10.85.
 - .6 On T Bar ceiling grid with drop in tile application, the flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB1 bracket. The bracket shall allow installation before the ceiling tile is in place.
 - .7 On T Bar ceiling grid designed for hard lid drywall application; the flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB2 bracket. The bracket

shall allow for the vertical adjustment of the reducer/head from below the drywall, post drywall installation.

- .8 On Hat Furring Channel grid with hard lid drywall application; the flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB4 bracket. The bracket shall allow for the vertical adjustment of the reducer/head from below the drywall, post drywall installation.
- .9 The braided drop system shall be cULus listed and FM Approved for sprinkler services to 175 psi (1206 kPa).
- .10 For dry sprinkler heads Victaulic VicFlex dry sprinkler model VS1. The sprinkler shall provide a vertical or horizontal flexible connection with a bend radius to 2", and allow for up to 4 bends. The sprinkler body shall be die cast brass with brass deflector, supplied finished to match application and to architectural direction, and glass bulb with glycerin solution. The product shall consist of a braided type 300 stainless steel flexible hose with a swivel type branch line threaded connection, EPDM gasket seal, with PTFE-coated Beryllium Nickel and stainless-steel spring-seal assembly. The bracket shall be open gate or metal strap to provide for sprinkler placement and alignment. The flexible dry sprinkler and bracket system is UL listed for sprinkler services to 175 psi.

2.02 Sprinkler Heads

- .1 Sprinkler heads, unless otherwise specified, are to be as scheduled in Part 3 of this Section.
- .2 Sprinkler body shall be die-cast, with a hex-shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation. Wrenches shall be provided by the sprinkler manufacturer that directly engage the wrench boss.
- .3 For locations where corrosive resistant coatings are required, body shall be coated with UL listed and FM approved anti-corrosion VC-250 coating (silver coloring).
- .4 Recessed sprinkler heads in finished areas are to be chrome plated unless otherwise specified. Concealed sprinkler head ceiling plates are to match ceiling colour.
- .5 Where exposed pendent heads occurs in areas with suspended ceilings, they are to be complete with chrome plated escutcheon plates. Similarly, sidewall heads with concealed piping are to be complete with chrome plated escutcheon plates.
- .6 Sprinkler heads which are exposed in areas where they may be subject to damage are to be complete with wire guards, chrome plated where in finished areas.
- .7 Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
- .8 Sprinkler heads located in areas or over equipment where high ambient temperature is present are to be, unless otherwise specified, 74°C (165°F) heads. All other heads, unless otherwise specified or required, are to be 57°C (135°F) rated.
- .9 Manufacturers:
 - .1 The Reliable Automatic Sprinkler Co;
 - .2 The Viking Corporation;
 - .3 Tyco Fire Suppression & Building Products;
 - .4 Victaulic Co.

3 Execution

3.01 Monitoring of Systems

- .1 Daily monitor and supervise existing sprinkler system serving renovated areas to ensure that each respective system is left in proper operating condition at end of each working day. Include for but not be limited to performing following:
 - .1 Under presence of Owner's representative, check each morning and evening (start and end of work) of each day, sprinkler system to ensure that it is in proper working condition;
 - .2 If portions of sprinkler system is not in proper working order, provide temporary provisions subject to approval of local fire authority or local governing authority, to ensure that proper sprinkler coverage is provided and/or provide supervisory personnel to monitor areas where sprinkler system is not operational;
 - .3 Document and sign off with Owner's representative signing off also, each respective daily check condition;
 - .4 Ensure that work to sprinkler system does not affect portion of system serving areas outside of renovation areas.

3.02 Demolition

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.03 Piping Installation Requirements

- .1 Provide required sprinkler system piping.
- .2 Perform piping work in accordance with requirements of NFPA 13, governing regulations, and "Reviewed" shop drawings.
- .3 Piping, unless otherwise specified, is as follows:
 - .1 for piping inside building and above ground except as noted below – Schedule 40 grooved end black steel with Victaulic or equal fittings and coupling joints, or, for piping to and including 50 mm (2") diameter, screwed fittings and joints, or, for piping 65 mm (2-½") diameter and larger, welding fittings and welded joints;
 - .2 for piping downstream of "head end" alarm valve(s) and equipment – Schedule 10 or "Lightwall" black steel pipe with Victaulic or equal fittings and coupling joints or screwed fittings and joints;
- .4 Exceptions to piping requirements specified above are as follows:
 - .1 PVC piping is not to be used above grade;
 - .2 ferrous pipe hangers, supports, and similar hardware used for galvanized steel piping are to be electro-galvanized.
- .5 Pipe sizes, pipe routing, sprinkler head quantities and locations, and layout of work shown on drawings are to assist during the tendering period. Ensure adequate head coverage, head quantities and pipe sizing as specified in Part 1 of this Section. Do not reduce size of sprinkler main or re-route the main unless approved by Consultant.
- .6 Pipe, fittings, couplings, flanges and similar components are to be clean after erection is complete. Wire brush clean any ferrous pipe, fitting, coupling, flange, hanger, support and similar component which exhibits rust and carefully coat with suitably coloured primer.

- .7 Where sprinklers are not protected by a dry system and may be subject to freezing, provide non-freeze, glycol-water solution filled sprinkler piping. Install piping complete with a CSA certified reduced pressure backflow preventer, valves, and glycol solution fill facilities in accordance with requirements of Chapter 3 of NFPA 13. Fill piping with a solution of 50% Union Carbide Canada Ltd. "UCAR THERMO-FLUID 17" or Dow Chemical Co. "Dowtherm SR1" propylene glycol with corrosion inhibitors, and 50% clean water. Prior to filling piping, check the specific gravity of the solution using a hydrometer with proper scale. Specific gravity is to be approximately 1.069 at 15.6°C.
- .8 When sprinkler work is complete, test system components and overall system(s) and submit completed test certificate and other documentation in accordance with Chapter 8 of NFPA 13.
- .9 Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks. Gaskets shall be molded and produced by the coupling manufacturer, and shall be verified as suitable for the intended service. A factory-trained field representative of the mechanical joint manufacturer shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed. Contractor shall remove and replace any improperly installed products.

3.04 Installation of Sprinkler Heads

- .1 Provide required sprinkler heads in accordance with following schedule:

Application	Sprinkler Head Type
Rooms/areas with a suspended ceiling	Victaulic V27 or Tyco Series TY-FRB recessed pendent
Rooms/areas without a suspended ceiling	Victaulic V27 or Tyco Series TY-FRB upright
Rooms/areas with sidewall sprinkler	Victaulic V27 or Tyco Series TY-FRB horizontal sidewall

- .2 Sprinkler head manufacturers indicated on schedule are for type indication purposes. Manufacturers are listed in Part 2 of this Section.
- .3 Coordinate sprinkler head locations with all drawings, including architectural reflected ceiling plan drawings, and, where applicable, electrical drawings. Coordinate sprinkler head locations in areas with suspended ceilings with the location of lighting, grilles, diffusers, and similar items recessed in or surface mounted on the ceiling as per the reflected ceiling plans. In areas with lay-in tile, centre the sprinkler head both ways in the lay-in tile wherever possible. Confirm locations prior to roughing-in.
- .4 Maintain maximum headroom in areas with no ceilings.
- .5 Provide guards for heads where they are subject to damage.
- .6 Provide high temperature heads in equipment rooms and similar areas over heat producing or generating equipment.

3.05 Spare Sprinkler Heads

- .1 Supply a full complement of spare sprinkler heads of types used (minimum 4 of each type) and hand over to owner.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for all products specified in this Section including 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 - DWV
 - .1 Equal to IPEX System XFR drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating not more than 25 and a smoke developed classification not more than 50 when tested to CAN/ULC-S102.2, with solvent weld joints or MJ Grey mechanical joint couplings, and, for fire barrier penetration, approved firestop conforming to CAN/ULC-S115.
- .2 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.
- .3 Cast Iron
 - .1 Class 4000 cast iron pipe, fittings, and mechanical coupling joints to CAN/CSA B70.
- .4 Stainless Steel – For Storm Drainage
 - .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 and coupling gaskets equal to Victaulic Grade P fluoroelastomer.

2.02 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.

2.03 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 Manufacturers:
 - .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.

2.04 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 finish are to be as above but with a square grate in lieu of a round grate.
- .3 Manufacturers:
 - .1 Watts Industries (Canada) Ltd.;
 - .2 Jay R. Smith Manufacturing Co.;
 - .3 Zurn Industries Ltd.;
 - .4 Mifab Inc.

2.05 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 Manufacturers:
 - .1 Watts Industries (Canada) Ltd.;
 - .2 Jay R. Smith Manufacturing Co.;
 - .3 Zurn Industries Ltd.;
 - .4 Mifab Inc.

3 Execution

3.01 Demolition

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Drain and Vent Piping Installation Requirements

- .1 Provide required drainage and vent piping. Pipe, unless otherwise specified, as follows:
 - .1 for pipe inside building and aboveground in sizes less than or equal to 65 mm (2-½") dia. – type DWV copper;
 - .2 for pipe inside building and aboveground in sizes greater than or equal to 75 mm (3") dia. – Class 4000 cast iron;
 - .3 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;
- .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 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').
- .4 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.
- .5 Provide cast brass dielectric unions at connections between copper pipe and ferrous pipe or equipment.

3.03 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 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.

3.04 Installation of Floor Cleanout Terminations

- .1 In waterproof floors, ensure each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit floor finish.
- .2 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.
- .3 Ensure cleanout termination covers in tiled floor are square in lieu of round.

3.05 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.

3.06 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.

End of Section

1 General

1.01 Section Includes

- .1 Refrigerant piping, joining materials, valves, fittings, and accessories for refrigerant piping.

1.02 References

- .1 CSA B52:18, Mechanical refrigeration code.

1.03 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 the Consultant for review.

1.04 Closeout Submittals

- .1 Submit letters from equipment suppliers certifying proper installation and start-up of piping systems and equipment as specified in Part 3 of this section.

1.05 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 Standard T style joints are not acceptable for a variable refrigerant volume system. Manufacturer specific Y joints shall be supplied by the VRF manufacturer.

2.02 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.

2.03 Shut-Off Valves

- .1 Ball Valves
 - .1 ¼ turn, CSA certified ball valves, each suitable for a maximum working pressure of 3792 kPa (550 psi), a ball position indicator on stem, and extended copper tube connections to permit brazing the valve into line without disassembling valve.
 - .2 Valve must be compatible with Refrigerant type used.
 - .3 Temperature operation of -40°C to 149°C (-40°F to 300°F)
 - .4 Full flow with zero pressure drop
 - .5 Bi-directional flow
 - .6 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.04 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 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.05 Piping Traps

- .1 Mueller Industries Inc. Style No. WE-554P brazing end copper "P" traps.
- .2 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.06 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 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.07 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 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.08 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 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.09 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 Manufacturers:
 - .1 Senior Flexonics Canada;
 - .2 The Metraflex Co.

2.10 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 Manufacturers:

- .1 Mueller Industries Inc.;
- .2 Sporlan Valve Co.;
- .3 Superior Refrigeration Products/Sherwood.

3 Execution

3.01 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 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.
- .4 Provide a refrigerant charging valve for each system if such a valve is not supplied integral with equipment.
- .5 Provide refrigerant piping accessories shown and/or required and install in accordance with manufacturer's recommendations.
- .6 Provide required refrigerant.
- .7 Provide flexible connections at piping connections to roof mounted condensing units. Install in accordance with manufacturer's instructions.
- .8 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 Section Includes

- .1 HVAC ducts and casings.
- .2 Acoustic duct lining material.
- .3 Special systems ductwork.
- .4 Dampers.
- .5 Other duct work accessories.

1.02 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 Submit duct leakage test data prior to ductwork being covered from view.
- .4 Provide air balancing report as per Specification Section 20 05 93.

1.03 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", CAN/ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, and supplied in 1.5 m (5') lengths.

.2 Insulated

- .1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-I", CAN/ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, supplied in 1.5 m (5') lengths and factory covered with 40 mm (1-½") 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 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.
- .2 Manufacturers:
- .1 Duro Dyne Canada Inc. "DUROLON";
- .2 Dyn Air Inc. "HYPALON".

2.04 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 Manufacturers:
- .1 Johns Manville;
- .2 Manson Insulation;
- .3 Knauf Insulation.

2.05 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 Manufacturers:
- .1 Johns Manville;
- .2 Manson Insulation;
- .3 Knauf Insulation.

2.06 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.

2.07 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	0.99	0.99	0.9	0.9

- .2 Manufacturers:

- .1 Vibro-Acoustics Ltd.;
- .2 Kinetics Noise Control Inc.;
- .3 Carrier Corp. – Racan;
- .4 Haakon Industries;
- .5 Price Industries Inc.;
- .6 Alumavent.

2.08 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.

2.09 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.

2.10 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.

2.11 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.

2.12 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 Manufacturers:
 - .1 Nailor Industries Inc.;
 - .2 T.A. Morrison & Co. Inc. "TAMCO";
 - .3 Greenheck Fan Corp.;
 - .4 Ruskin Co.

2.13 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.

2.14 Wire Mesh

- .1 Heavy-gauge galvanized steel or aluminum mesh, 12 mm x 12 mm (½" x ½") secured in a rigid galvanized steel or aluminum framework, sized as indicated on drawings, and constructed so as to be removable.

2.15 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 Manufacturers:
 - .1 Price Industries Inc.;

- .2 Anemostat;
- .3 Krueger Division of Air System Components Inc.;
- .4 Titus;
- .5 Nailor Industries Inc.;
- .6 Tuttle & Bailey.

3 Execution

3.01 Cleanliness Requirements for Handling and Installation of Ductwork

- .1 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 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 the Consultant. Duct routing and/or dimension revisions to suit conditions at site are not grounds for a claim for an extra cost.
- .4 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.
- .5 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.
- .6 Install (but do not connect) duct system mounted automatic control components supplied as part of the automatic control work.
- .7 Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.
- .8 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.
- .9 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 the Consultant.
- .10 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.

- .11 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.
- .12 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 the 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 the 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.
- .13 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.
- .14 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.
- .15 Where dissimilar metal ducts are to be connected, isolate ducts by means of flexible duct connection material.

3.03 Installation of Flexible Ductwork

- .1 For supply air ductwork, provide maximum 1.5 m fully stretched, 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.

3.04 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 fan coils for a distance of 2.4 m (8') measured along duct and outward from box in all directions;
 - .3 return duct to fan coil
- .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.

3.05 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.

3.06 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.

3.07 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.

3.08 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.

3.09 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 fan coils, 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.

3.10 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.

3.11 Installation of Wire Mesh

- .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 ULC requirements.

3.12 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 Confirm grille and diffuser finishes prior to ordering.

3.13 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 Section Includes

- .1 Variable Refrigerant Flow (VRF) air conditioning system consisting of one or more outdoor compressor units and multiple indoor fan coil units.

1.02 Related Requirements

- .1 Section 23 23 00 – Refrigerant Piping.

1.03 Submittals

- .1 Submit shop drawings/product data sheets, complete with control components, and piping and wiring schematics.
- .2 Prepare and submit a schematic layout of refrigerant piping showing all piping components required for satisfactory operation and maintenance of the system(s), including but not limited to pipe sizes, charging valve, CSA B52 refrigerant charge analysis, isolating valves, sight glasses, strainers, driers, traps, etc. Schematic diagram must be reviewed with and approved by air conditioning equipment supplier prior to submittal to the Consultant.

1.04 Closeout Submittals

- .1 Submit a start-up and certification letter from equipment supplier as specified in Part 3 of this Section.

1.05 Quality Assurance

- .1 Split system air conditioning equipment and installation of equipment are to be in accordance with requirements of following:
 - .1 All applicable provincial codes and standards;
 - .2 ANSI/AHRI Standard 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - .3 ANSI/AHRI Standard 1230. Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment
 - .4 ANSI/UL STD 1995. Heating and Cooling Equipment.
- .2 Split system air conditioning system installation tradesmen are to be journeyman refrigeration mechanics.

2 Products

2.01 General

- .1 VRF system shall automatically vary the target evaporating and condensing temperatures based on building load and weather conditions to increase part load efficiency (Variable Refrigerant Temperature). The condensing unit shall also feature customizable operating modes which allows for the manual setting of target evaporating and condensing temperatures.
- .2 System shall be a two-pipe heat pump switchover VRF system. All indoor units on single refrigerant circuit shall operate in the sae mode (heating or cooling). The specified system is not a simultaneous heating and cooling heat recovery system. Refer to the controls section of this specification for any central controller and/or mode switchover sequence that may be required.

- .3 All VRF condensing units on the project, for the VRF indoor units, and for the air handling units, shall be from the same manufacturer.

2.02 Manufacturers

- .1 Daikin Industries Ltd.;
- .2 Mitsubishi Electric Sales Canada Inc.;
- .3 LG Canada.

2.03 Refrigerant Piping

- .1 Refer and comply to the refrigerant piping specification 23 23 00 – Refrigerant piping, including the special considerations for VRF refrigerant piping section.
- .2 Standard T style joints are not acceptable for a variable refrigerant volume system. Manufacturer specific Y joints shall be supplied by the VRF manufacturer.

2.04 VRF Fan Coils

- .1 VRF fan coils shall monitor and maintain the unit superheat (cooling mode) or subcooling (heating mode) using a computerized PID control. Internal unit components shall be factory wired and piped, and complete with electronic proportional expansion valve, flare connections, condensate drain pan, self-diagnostics, and auto-restart function.
- .2 Wall Mounted Unit
 - .1 Wall mounted fan coil unit for installation onto a wall within a conditioned space. A mildew-proof, polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment.
 - .2 The indoor unit's sound pressure shall range from 31 dB(A) to 43 dB(A) at low speed measured at 1 m (3.3 feet) below and 1 m (3.3 feet) away from the unit.
 - .3 The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge angle. The front grille shall be easily removed for washing.
 - .4 The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.
 - .5 The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
 - .6 The fan type shall be direct-drive cross-flow with statically and dynamically balanced impeller with high and low fan speeds available.
 - .7 Units shall be provided with a loose field installed condensate pump.
- .3 Concealed Ceiling Mounted Ducted Unit
 - .1 Built-in concealed ceiling mounted ducted fan coil unit with variable speed direct drive DC type fan and auto CFM adjustment at commissioning. Casing shall be constructed of galvanized steel. Configuration shall be horizontal discharge air with horizontal return air, with a maximum height of 9-5/8" and be designed to fit in tight ceiling plenums.
 - .2 The indoor unit's sound pressure shall range from 28 dB(A) to 39 dB(A) at low speed measured 1.5m (5 feet) below the ducted unit.

- .3 The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump shall provide up to 25" of lift from the center of the drain outlet and have a built-in safety shutoff and alarm.
- .4 The fan shall have a variable speed direct drive DC motor with statically and dynamically balanced impeller with 3 user-selectable fan speeds. The automatic fan speed mode shall allow the fan to vary between 5 speeds based on space load. The unit shall have logic for automatically adjusting external static pressure settings of the fan motor (selectable during commissioning).
- .5 The unit shall ship from the factory in a rear return configuration and shall be field convertible to a bottom return configuration.

2.05 Air Cooled Condensing Unit

- .1 The condensing unit shall be factory assembled in North America and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of inverter scroll compressors, motors, fans, heat exchanger, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver (heat recovery only) and suction accumulator.
- .2 The system will automatically restart operation after a power failure and will not cause any settings to be lost.
- .3 The unit shall incorporate an auto-charging feature to ensure proper refrigerant charge.
- .4 The following safety devices shall be included on the condensing unit: high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter, and anti-recycling timers.
- .5 The inverter scroll compressors shall be high efficiency reluctance DC (digitally commutating), hermetically sealed, variable speed type. Temperatures and pressures shall be read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value. Non inverter-driven compressors shall not be accepted.
- .6 Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. Upon complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
- .7 The compressors' motors shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.
- .8 Inverter board shall be refrigerant-cooled to prevent inefficient and unstable operation that can result from air-cooled inverter boards due to varying ambient conditions.
- .9 The compressor shall be internally isolated to avoid the transmission of vibration.
- .10 In the case of multiple condenser modules, operation hours of the compressors shall be balanced by means of the Duty Cycling Function.
- .11 The variable speed inverter compressors in Air-Cooled systems shall also use Flash Vapor injection technology with back pressure control for reduced leakage and additional balancing weights on main shaft for increased compressor lifetime.
- .12 The fan motor shall have inherent protection and permanently lubricated bearings. The motor shall be provided with a fan guard to prevent contact with moving parts. The condensing unit shall consist of one or more propeller type, direct-drive 600 W fan motors that have multiple speed operation via a DC (digitally commutating) inverter. Motors shall be capable of delivering design air at high external static

- pressures up to 0.32 in WG (factory set as standard at 0.12 in. WG) to accommodate field applied condensing unit discharge ductwork.
- .13 The condensing units shall have configurable settings for intermittent fan operation to help minimize snow accumulation on fan blades when the system is off.
 - .14 Night setback control for low noise operation shall automatically limit the maximum speed of the fan motor.
 - .15 The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tubes with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
 - .16 The fins are to be covered with an anti-corrosion hydrophilic blue coating as standard with a salt spray test rating of 1000 hr (ASTM B117 and Blister Rating:10), Acetic acid salt spray test of 500 hr (ASTM G85 and Blister Rating:10).
 - .17 The outdoor unit shall be capable of heating operation down to -13°F ambient temperature. Tested factory data on heating capacity and efficiency shall be available. Continuous heating shall be provided during defrost mode for multi-module systems.
 - .18 Multi-module systems shall have the ability to be “valved off” and isolated for start-up and operation with less than 50% connection ratio.
 - .19 The system serving HRV-1 shall be able to switch between heat pump heating and gas furnace heating at a field selectable change-over temperature which can be configured via condensing unit field setting.
 - .20 Each system shall include a built-in data recorder that can store up to 45 minutes of operational data which can help identify the issue in case of a product failure.
 - .21 The outdoor unit shall be capable of heating operation down to -25°C (-13°F) ambient temperature. Tested factory data on heating capacity and efficiency shall be available.
 - .22 The lower part of the outdoor coil shall be used for inverter cooling, enhancing defrost during heating operation.
 - .23 The outdoor units shall be complete with Snow/Wind Hood Kits for protection from snow built-up and wind in cold climates.

2.06 DX Coil

- .1 Certification – Acceptable refrigerant coils are to be certified in accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer's certification and/or the range of AHRI's standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410.
- .2 Coils designed for use with Refrigerant R-410A. Fins shall have a minimum thickness of 0.0075" of aluminum plate construction with full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary-to-secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tube shall not be visible between fins.
- .3 Refrigerant coils shall be provided with round seamless 3/8" O.D. copper tubes on 1-1/2" centres, staggered in the direction of airflow. All joints shall be brazed.

- .4 Sweat type copper suction connections located at the bottom of the suction headers for gravity oil drainage. Coils shall be uniformly circuited in counterflow manner for interlaced face split capacity reduction. Pressure type liquid distributors used. Coils shall be tested with 315 pounds air pressure under warm water, and suitable for 250 psig working pressure.

2.07 Expansion Valve

- .1 VRF system shall monitor and maintain the unit superheat (cooling mode) or subcooling (heating mode) using a computerized PID control. Internal unit components shall be factory wired and piped, and complete with electronic proportional expansion valve, flare connections, condensate drain pan, self-diagnostics, and auto-restart function.
- .2 Expansion valve shall be the diaphragm and spring- loaded type with external equalizers, and bulb and capillary tubing. Valve shall be equipped with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 1°C (2°F) of saturated suction temperature at evaporator conditions. Pilot-operated valves shall have a characterized plug to provide required modulating control.
- .3 Electronic expansion valves shall be brass body, needle valve with floating needle and machined seat, stepper motor drive and compatible with R-410A and PVE oil.
- .4 Electronic expansion valves shall have a temperature operation of -40°C to 149°C (-40°F to 300°F).
- .5 Electronic expansion valves shall have a working pressure of 3795 KPa (550 psig) and should be able to handle up to 4826 KPa (700 psig).
- .6 The access port of the expansion valve must be on the valve body and not on the piping.
- .7 Electronic expansion valves shall be able to handle the flow without any pressure drop.
- .8 Electronic expansion valves shall be able to work with bi-directional flows.

2.08 Local Controls – HRV-1

- .1 VRF system, where indicated, are to be integrated with make-up air unit HRV-1, utilizing a VRF DX coil, electronic expansion valves and appropriate controls. VRF manufacturer shall provide the DX coil(s), electronic expansion valves and controllers.
- .2 Expansion valves, expansion valve controller, and thermistors shall be field mounted, powered, and wired on the make-up air unit HRV-1.
- .3 Systems intended for discharge air temperature control shall be provided with the appropriate expansion valve controller (W-Control):
 - .1 Expansion valve controller shall regulate the discharge air temperature proportional to the external 0-10VDC input signal supplied from the air handling unit(s) DDC controller, BAS, or equivalent centralized controls.
 - .2 Air handling unit's DDC controller, or BAS, shall be directly wired to the VRF condensing unit (ABC board) for control of mode of operation (between heating and cooling).
 - .3 Expansion valve controller shall have ports for ON/OFF control.
 - .4 Expansion valve controller shall have ports for alarm/error status.
 - .5 Expansion valve controller shall have ports for operation status.

- .6 Expansion valve controller shall have ports for ventilation fan ON/OFF control. The ventilation contacts shall close when the expansion valve controller is in ON mode. Modulation of ventilation device by others.
- .7 Expansion valve controller shall be wired to and communicate with the VRF condensing units.
- .4 Expansion valve controller shall be provided with all required thermistors for proper electronic control of expansion valve. Thermistors shall be field mounted in the appropriate airstream and both liquid and suction refrigerant lines.
- .5 Air handling unit DX coils shall be connected to VRF condensing units equipped with inverter compressor.

2.09 Local Controls – Fan Coils

- .1 Fan coil units shall be supplied with a 3rd party thermostat adaptor.
- .2 The interface adaptor shall have LED lights to indicate operation and communication.
- .3 The communication wire of the interface adaptor shall be wired to indoor unit PCB. When connected with a third-party thermostat, the interface adaptor shall obtain 24 VAC from an external power supply.
- .4 The wiring from the interface to the thermostat shall be 18 AWG, 6-conductor non-shielded wire. The wiring from the Interface to the indoor unit termination and power terminal shall be provided in the product packaging. The communication wire from the interface adaptor to the indoor unit connection shall be provided in the product packaging.
- .5 The interface adaptor shall be mounted onto a flat surface with screws.
- .6 Shall be wired by installing contractor.
- .7 Shall be able to dynamically increase and decrease the indoor unit internal setpoint by a preset degree based upon the indoor unit status and the G/Y/W request status from the thermostat.

2.10 Central Controls

- .1 Provide VRF system with the ability to connect to the building BMS with BACnet Application Specific Controller (B-ASC) via BACnet IP or MS/TP.
- .2 B-ASC device shall enable a direct connection to a BACnet IP or MS/TP master device (SCADA, PLC, DDC or equivalent) via a CAT6 or EIA485 network.
- .3 B-ASC shall be wired and installed by the BMS contractor. B-ASC shall not require external power.
- .4 VRF manufacturer shall commission the BACnet devices. BMS contractor shall provide VRF manufacturer with the address points for commissioning.
- .5 All programming for monitoring and control of VRF system via the BACnet IP or MS/TP devices shall be by BMS contractor, as per the Sequence of Operation.

2.11 Electrical

- .1 The control voltage between the indoor and outdoor unit shall be 16 VDC. The control wiring shall be communication type stranded non-shielded 18-2 AWG.
- .2 Control wiring shall be installed in a daisy chain configuration between all VRF components as per Manufacturer.

3 Execution

3.01 Installation

- .1 Provide VRF equipment consisting of exterior condensing units and indoor evaporator units as scheduled and/or indicated on the drawings.
- .2 VRF systems, where indicated, are to be integrated with unit(s), electronic expansion valve(s) and appropriate controls. VRF manufacturer shall provide the DX coil(s), electronic expansion valves and controllers where indicated on drawing.
- .3 Contact manufacturer or manufacturer's representative prior to installation to review and confirm piping layout and lengths.
- .4 Units shall be stored and handled according to the manufacturer's recommendations. Units shall be kept clean and isolated from dust and debris.
- .5 Contractor shall inspect all equipment upon delivery and notify shipping company and manufacturer immediately of any damage.
- .6 Install condensing units on a flat surface level within 1/8 in and elevate a minimum of 18 in from ground or roof surface, on vibration isolation pads. Provide intermediate supports as recommended by the equipment manufacturer. Provide intermediate supports with factory provided condensate drip trays. The drip trays are to be field wired with heat trace and connected to nearby drain with heat traced drain line, as shown on drawings.
- .7 Indoor evaporator units to be installed as located on the drawings. Confirm exact location prior to roughing-in.
- .8 Install loose control components and perform required control wiring (except building automation system connections) between condensing unit and evaporator in conduit in accordance with manufacturer's control wiring schematic and wiring standards of electrical work.
- .9 Connect condensing unit and indoor evaporator units with refrigerant piping in accordance with piping shop drawing schematic. Refer to Section 23 23 00. Provide any required additional refrigerant.
- .10 High/low pressure gas line, liquid, and suction lines must be individually insulated between the outdoor and indoor units.
- .11 Use refrigeration best practice to allow pipes to expand and contract freely. Review manufacturer installation instructions to ensure expansion joints are properly designed.

3.02 Startup and Adjusting

- .1 Pressure test all systems to 550 psi after system has been vacuumed and held to below 500 microns for at least one hour. Review manufacturer installation instructions for proper pressure test procedures.
- .2 Design and install all piping as per TSSA and CSA B52 regulations and apply and obtain TSSA certification for all systems.
- .3 Contractor to carry the cost of a minimum of two (2) manufacturer field inspection to review installation and startup. Notify consultant minimum of five days prior to inspection.
- .4 Refer to Section 20 05 00 – Common Work Results for Mechanical; for equipment/system manufacturer certification and start-up requirements.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for following:
 - .1 all control system components;
 - .2 identified schematic control diagrams with component identification, catalogue numbers, and sequence of operation for all systems;
 - .3 certified wiring diagrams for all systems.
- .2 Submit following samples for review:
 - .1 wall mounting control system flow diagram as specified in Part 2 of this Section;
 - .2 each type of thermostat to be used, each identified as to intended use.

1.02 Closeout Submittals

- .1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.
- .2 Submit written confirmation from control component manufacturer that site installation personnel are qualified and experienced in installation of components, and have parts and service availability on a 24/7 basis.

1.03 Quality Assurance

- .1 Control systems are to be installed by control component manufacturer or by licensed personnel authorized by control component manufacturer. Submit written confirmation from control component manufacturer.
- .2 Control wiring work is to be performed by licensed journeyman electricians, or under direct daily supervision of journeyman electricians.
- .3 Refer to attached Owner Master Specifications and System Integration Specifications.

2 Products

2.01 Automatic Control Valves and Operators

- .1 Each control valve must be suitable in all respects for the application, including system pressure, and must have design output and flow rates.
- .2 Body and trim materials selected in accordance with specification for globe valves, ball valves, or high performance butterfly valves, and in accordance with manufacturer's recommendations for design conditions and service.
- .3 Size control valves for pressure drops and heating and cooling loads as scheduled with same pressure rating as globe valves under same service and pressure conditions.
- .4 Size valves for two port and three port, two position service;
 - .1 line size,
 - .2 ball valves, sizes NPS 1-1/2 and smaller,

- .3 butterfly valves, sizes NPS 2 and larger.
- .5 For two port and three port modulating service;
 - .1 use globe valves for CV rating 160 and smaller,
 - .2 use butterfly valves for CV rating above 160.
- .6 Select butterfly valves based on CV rating at 70° rotation
- .7 Hydronic system valves;
 - .1 two position service;
 - .1 straight through two port type, single seated, with replaceable disc or ball,
 - .2 quick opening linear or equal percentage flow characteristics.
 - .2 modulating service;
 - .1 straight through two port type, single seated,
 - .2 equal percentage flow characteristics.
 - .3 modulating diverting service; three port mixing valves,
 - .1 linear for each port to give constant total flow or,
 - .2 equal percentage flow characteristics with 25% valve authority (valve pressure drop equal to 33% pressure drop through load at full flow).
 - .4 actuator and trim selected for close-off pressure ratings as follows;
 - .1 two-way modulating or two position service; 150% of pump shut off head.
 - .2 three-way modulating service; 300% of pressure differential between ports A and B at design flow or 100% of pump shut off head.
 - .3 shut off head to be based on maximum rpm when pump is fitted with VFD.
 - .5 sized as follows;
 - .1 for two-position service; line size.
 - .2 for two-way modulating service unless otherwise shown; pressure drop at design flow equal to greatest of;
 - .1 200% of pressure drop through heat exchanger,
 - .2 100% of pressure drop through coil,
 - .3 50% of pressure difference between supply and return mains, or
 - .4 35 kPa (5 psi).
 - .3 for three-way modulating service; pressure drop equal to smaller of;
 - .1 twice pressure drop through coil or heat exchanger, or
 - .2 35 kPa (5 psi).

- .4 for valves for radiation, terminal units and reheat coils;
 - .1 pressure drop of 7 kPa (1 psig)
- .6 failed position on isolation from control signal as follows;
 - .1 Heating water and glycol zone valves; fail open.
 - .2 Hot water and glycol differential pressure by-pass control valves; fail closed.
- .8 Valve actuators for service on radiation, radiant panel, and reheat coil valve applications;
 - .1 output shaft driven by gear train mechanism.
 - .2 reversible motor with automatic load limit,
 - .3 input type and range as suitable for interfacing to output of BAS controllers,
 - .4 adjustable span and offset travel,
 - .5 position feedback signal on actuators used for proportional control,
 - .6 general purpose, dustproof, die-cast aluminum housing,
 - .7 actuator rotation limit.

2.02 Control Dampers and Operators

- .1 T. A. Morrison & Co. Inc. "TAMCO" 100 mm (4 in) deep, flanged, AMCA low leakage certified aluminium dampers. Dampers for modulating and mixing applications are to be parallel blade type. Dampers for open-shut service are to be opposed blade type. Maximum blade length is to be 1 m (4 ft). Dampers greater than 2 sections wide are to be complete with a jackshaft. Each damper is to be complete with:
 - .1 extruded 6063T5 aluminum frame and airfoil blades, each with an integral slot to receive a gasket;
 - .2 extruded TPE frame gaskets and extruded EPDM blade gaskets;
 - .3 slip-proof aluminium and corrosion resistant plated steel linkage of a metal thickness to prevent warping or bending during damper operation, concealed in frame, equipped with seal-sealing and self-lubricating bearings consisting of a Celcon inner bearing fixed on hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in frame.
- .2 For standard damper(s), Series 1000 as above.
- .3 Each damper motor is to be shaft mounted, spring return, fail safe in the normally open or normally closed position, sized to control damper against maximum pressure or dynamic closing pressure, whichever is greater, to suit sizes of dampers involved, and to provide sufficient force to maintain damper rated leakage characteristics. Each operator is to be complete with a damper position indicator, and external adjustable stops to limit length of stroke in either direction, and is to be mounted on a corrosion resistant adjustable bracket. Operating arms are to have double yoke linkages and double set screws for fastening to damper shaft. Operators for dampers to be connected to building fire alarm system or to freeze protection devices are to be equipped with additional relays to permit dampers to respond and go to required position in less than 15 s upon receipt of a signal. Operator enclosures are to be suitable in all respects for environment in which they are located.
- .4 Electric damper operators are to be equal to Belimo EF Series 24 V or 120 VAC spring return, direct coupled electric motor operators for either modulating or 2-position control as required. Each operator is to be overload protected and complete with an enclosure to suit the mounting location.

2.03 Control System Components

- .1 Components specified below are required for control of equipment and systems in accordance with drawing control diagrams and sequences of operation. Not all required components may be specified.
- .2 Sensor/transmitter input devices must be suitable in all respects for the application and mounting location. Devices are as follows:
 - .1 unless otherwise specified, temperature sensors are to be resistance type, either 2-wire 1000 ohm nickel RTD or 2-wire 1000 ohm platinum RTD with accuracy (includes errors associated with sensor, lead wire, and A to D conversion), equipped with type 316 stainless steel thermowells for pipe mounting applications, as follows:
 - .1 chilled water, room temperature, and duct temperature points, $\pm 1^{\circ}\text{C}$ ($\pm 0.5^{\circ}\text{F}$);
 - .2 all other points, $\pm 0.75^{\circ}\text{C}$ ($\pm 1.3^{\circ}\text{F}$).
 - .2 room temperature sensors constructed to be selected in accordance with the following classifications:
 - .1 Type 1: Space temperature sensor (private/non-public areas);
 - .1 for measurement of space temperature only as shown on the floor plans and/or as described in the Sequence of Operation;
 - .2 set-point adjustment shall be accessible through the cover;
 - .3 sensor operating temperature range from 4°C to 60°C (40°F to 140°F);
 - .4 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors;
 - .5 mono-chromatic guard secured to mounting plate by screws;
 - .2 Type 2: Space temperature sensor (public areas or secure areas);
 - .1 for measurement of space temperature of space temperature only in areas subject to vandalism as shown on the floor plans and/or as described in the Sequence of Operation;
 - .2 sensor operating temperature range from 4°C to 60°C (40°F to 140°F);
 - .3 stainless steel flat plate surface type with sensor epoxy-bonded to back of cover plate;
 - .4 tamperproof/secure concealed fasteners;
 - .5 set-point adjustment is to be concealed behind the cover.
 - .3 Type 3: Adjustable space temperature sensor with display (Private Areas, Office areas);
 - .1 for measurement and adjustment of space temperature as shown on the floor plans and/or as described in the Sequence of Operation;
 - .2 digital set point operating temperature adjustment range from 4°C to 60°C (40°F to 140°F);
 - .3 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors;

- .4 mono-chromatic guard secured to mounting plate by screws;
 - .5 on/off button to allow occupant override feature;
 - .6 three-digit LED digital temperature display with 0.2° display resolution;
 - .7 5% to 95% relative humidity, non-condensing;
 - .8 minimum/maximum limit set point values adjustable from the BAS operator interface and controller.
 - .9 set-point adjustment is to be accessible through the cover.
- .3 outside air sensors designed and constructed for an ambient temperature of -25°C to 60°C (-13°F to 140°F) and 5% to 95% relative humidity, non-condensing, complete with a NEMA 3R enclosure, solar shield, a weatherproof seal at all wall penetrations, and a perforated plate surrounding sensor element where exposed to wind velocity pressure;
- .4 insertion duct mounting sensors type with lock nut and mounting plate, designed to mount in an electrical box (weatherproof with gasket and cover where outside) through a hole in duct;
- .5 for ducts greater than 1.2 m (4 ft) or for ducts where air temperature stratification occurs, averaging type sensors with multiple sensing points, and for plenums for applications such as mixed air temperature measurement to account for air turbulence and/or stratification, an averaging string of sensors with capillary supports on the sides of duct/plenum;
- .6 Where both temperature and humidity are shown to be measured at same location or in same airstream, use of single measuring unit is permitted provided that features and performance of both temperature sensor and humidity sensor are in accordance with requirements of this specification.
- .3 factory solid-state relative humidity sensors with an element that resists contamination, weather-proof with a NEMA 3R enclosure for outside air applications, supplied with a type 304 stainless steel probe with mounting bracket and hardware for duct mounting, each complete with a factory calibrated humidity transmitter which is accurate (including lead loss and analog to digital conversion) to 3% between 25°C to 60°C (-13°F to 140°F) and 5% to 95% relative humidity, non-condensing and complete with non-interactive span and zero adjustments, and a 2-wire isolated loop powered, 4-20 mA, 0 to 100% linear proportional output;
- .4 carbon dioxide sensors for air quality control purposes having a maximum 20 s response time, suitable for operating conditions from 0°C to 50°C (32°F to 122°F) and 0 to 100% RH non-condensing, complete with a calibration kit (to be handed to Owner) and characteristics as follows:
- .1 measurement range: 0 to 2000 ppm;
 - .2 accuracy: ±100 ppm;
 - .3 repeatability: ±20 ppm;
 - .4 drift: ±100 ppm per year;
 - .5 output signal: 0-10 VDC proportional over the 0 to 2000 ppm range.
- .5 Pressure transmitters are to be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input. Pressure transmitters are to transmit a 0 to 5 VDC, 0-10 VDC, or 4-20 mA output signal. Differential pressure transmitters used for flow measurement are to be sized to the flow sensing device and supplied with a tee fitting and shut-off valves in the high and low sensing pick-up lines to allow permanent ease of use connection for

balancing, etc. Transmitter housing is to suit mounting location. Standalone pressure transmitters are to be mounted in a minimum NEMA 1 (NEMA 2 in sprinklered area) by-pass valve assembly panel with high and low connections piped and valved, air bleed units, by-pass valves, and compression fittings. Transmitters are to be as follows:

- .1 low differential water pressure, 0 to 5 kPa (0 to 20" wc): equal to Setra or Mamac industrial quality transmitter capable of transmitting a linear 4-20 mA output signal in response to variation of flow meter differential pressure or water pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:
 - .1 maintain accuracy up to 20 to 1 ratio turndown;
 - .2 reference accuracy: +0.2% of full scale.
- .2 medium to high differential water pressure, over 5 kPa (20" wc): equal to Setra or Mamac transmitters as specified above for low pressure transmitters but with a pressure range of from 2.5 kPa (10" wc) to 2070 kPa (300 psi), a reference accuracy of $\pm 1\%$ of full span (includes non-linearity, hysteresis, and repeatability);
- .3 building differential air pressure: equal to Setra or Johnson Controls Inc. industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4-20 mA output in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:
 - .1 maintain accuracy up to 20 to 1 ratio turndown;
 - .2 reference accuracy: +0.2% of full span.
- .4 low differential air pressure, 0 to 1.25 kPa (0" to 5" wc): equal to Setra or Johnson Controls Inc. industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4-20 mA output signal in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:
 - .1 maintain accuracy up to 20 to 1 ratio turndown;
 - .2 reference accuracy: +0.2% of full span.
- .5 medium differential air pressure, over 1.5 kPa (5" wc): equal to Setra or Johnson Controls Inc. transmitters as specified above for low pressure air transmitters but performance requirements as follows:
 - .1 zero and span: (c/o F.S./°F); 0.04% including linearity, hysteresis, and repeatability;
 - .2 accuracy: 1% F.S. (best straight line); static pressure effect: 0.5% F.S.;
 - .3 thermal effects: less than +0.33 F.S./°F over 40°F to 100°F (calibrated at 70°F).
- .6 Air and water flow monitoring stations and probes are to be Air Monitor Corp., Tek-Air Systems Inc., Ebtron, or Dietrich Standard products as follows:
 - .1 Fan Inlet Air Flow Measuring Station: At fan inlet and near exit of inlet sound trap, air flow traverse probes are to continuously monitor fan air volume and system velocity pressure, and traverse probes are to be as follows:
 - .1 each probe is to be of a dual manifold, cylindrical, anodized type 3003 extruded aluminium construction probe with sensors located along the stagnation plane of

- approaching air flow, and the static pressure manifold is to incorporate dual offset static tops on opposing sides of averaging manifold so as to be insensitive to flow angle variations for as much as $\pm 20^\circ$ in approaching air stream;
- .2 each probe is not to introduce a measurable pressure drop, nor is sound level within duct to be amplified by its singular or multiple presence in air stream, and each probe is to contain multiple static and total pressure sensors placed at equal distances along its length in accordance with ASHRAE Standards for duct traversing.
 - .2 Single Probe Air Flow Measuring Sensor: Duct mounting hot wire anemometer type which utilizes 2 temperature sensors, one is a heater element temperature sensor and the other is to measure downstream temperature, with temperature differential related directly to air flow velocity. Sensor insertion length is to be adjustable up to 200 mm (8 in), and transmitter is to produce a 4-20 mA or 0-10 VDC signal linear to air velocity.
 - .3 Duct Flow Measuring Stations: 14 gauge galvanized steel casing with duct connection flanges of a size to mate with connecting ductwork, and complete with an air directionalizer and a 98% free area parallel cell 20 mm (3/4") honeycomb profile suppressor across entering air stream to equalize velocity profile and eliminate turbulent and rotational flow from the air stream prior to measuring point, mechanically fastened to casing so as to withstand velocities of up to 1828 m (6000 ft) per minute. Additional requirements as follows:
 - .1 total pressure measurement side (high side) is to be designed and spaced to requirements of Industrial Ventilation Manual, 16th Edition, page 9-5, and self-averaging manifolding is to be constructed of brass and copper components;
 - .2 static pressure sensing probes (low side) is to be bullet-nose shaped, per detailed radius, as illustrated in Industrial Ventilation Manual referred to above, page 9-5;
 - .3 main take-off point from both total pressure and static pressure manifolds is to be symmetrical, and manifolds are to terminate with external ports for connection to control tubing;
 - .4 each station is to be equipped with a label on casing indicating unit model number, size, area, and specified air flow capacity;
 - .5 each station is to have a self-generated sound rating of less than NC 40, and sound level within duct is not to be amplified nor is additional sound to be generated.
 - .4 Static Pressure Traverse Probe: Duct mounting, complete with multiple static pressure sensors located along exterior surface of cylindrical probe.
 - .5 Shielded Static Air Probe: Indoor type or outdoor type as required, each with multiple sensing ports, an impulse suppression chamber, and air flow shielding.
 - .6 Water Flow Monitoring: Equal to Onicon microprocessor-based electromagnetic water flow meters with an accuracy of 0.25%.
 - .7 Power (amps) monitoring is to be performed by a combination of a current transformer and a current transducer with transformer sized to reduce full amperage of monitored circuit to a maximum 5 A signal which will be converted to a 4-20 mA DDC compatible circuit for use by building automation system. Current transformer and current transducer are as follows:
 - .1 equal to Veris Industries split core current transformer with an operating frequency of from 50 Hz to 400 Hz, 0.6 kV class, 10 kV BIL insulation, and 5 A secondary;

- .2 equal to Veris Industries current to voltage or current to mA transducer with an accuracy of $\pm 5\%$, a minimum load resistance of 30 kOhm, an input of 0 to 20 A and an output of 4-20 mA, and a 24 VDC regulated power supply.
- .8 Duct mounting smoke detectors supplied as part of electrical work for mounting as part of control system work.
- .9 Double contact switches to monitor equipment status and safety conditions, and generate alarms when a failure or abnormal condition occurs. Status and safety switches are to be as follows:
 - .1 current sensing switches: equal to Veris Industries self-powered dry contact output switches for sensing run status of motor loads, each calibrated to indicate a positive run status only when motor is operating under load, and each consisting of a current transformer, a solid-state current sensing circuit, adjustable trip point, solid-state switch, SPDT relay, and a LED to indicate on or off status;
 - .2 air filter status switches: equal to Johnson Controls Inc. or Cleveland Controls automatic reset type differential pressure switches, each complete with SPDT contacts rated for 2 A at 120 VAC, a scale range and differential pressure adjustment appropriate for the service, and an installation kit which includes static pressure taps, tubing, fittings, and air filters;
 - .3 air flow switches: equal to Johnson Controls Inc. or Cleveland Controls pressure flow switches, bellows actuated mercury switch or snap-acting micro-switch type with an appropriate scale range and pressure adjustment;
 - .4 air pressure safety switches: equal to Johnson Controls Inc. or Cleveland Controls manual reset switches, each complete with SPDT contacts rated for 2 A at 120 VAC and an appropriate scale range and pressure adjustment;
 - .5 low temperature limit switches: manual reset type equal to Johnson Controls Inc. Model A70, each complete with DPST snap acting contacts rated for 16 A at 120 VAC, a minimum 4.5 m (15 ft) sensing element for mounting horizontally across duct/plenum with sensing reaction from coldest 450 mm (18 in) section of element, and where sensing element does not provide full coverage of air stream, additional switches are to be supplied as required.
- .10 Control relays as follows:
 - .1 control pilot relays: equal to Johnson Controls Inc. or Lectro modular plug-in design with snap-mount mounting bases, retaining springs or clips, DPDT, 3 PDT or 4 PDT as required for the application, with contacts rated for 10 A at 120 VAC;
- .11 Electronic signal isolation transducers equal to Advanced Control Technologies for installation whenever an analog output signal from building automation system is to be connected to an external control system as an input (i.e. equipment control panel), or is to receive as an input signal from a remote system, and to provide ground plane isolation between systems.
- .12 Each manual override station is to be complete with contacts rated minimum 1 A at 24 VAC and is to provide following:
 - .1 integral H-O-A switch to override controlled device pilot relay;
 - .2 status input to building automation system to indicate whenever switch is not in the Auto position;
 - .3 status LED to illuminate whenever output is On;
 - .4 override LED to illuminate whenever H-O-A switch is in either the Hand or Off position.

- .13 Electronic/pneumatic transducers equal to Johnson Controls Inc. transducers with an output of from 3 psig to 15 psig, an input of from 4-20 mA or 0-10 VDC, manual output adjustment, a pressure gauge, and an external replaceable supply air filter.
- .14 Thermostats:
 - .1 Wall mounting adjustable set-point thermostats, each suitable in all respects for equipment (and operating sequence) they are provided for, equipped with a thermometer, a cover and any required mounting and connection accessories.
 - .2 Low voltage thermostats are to be 24 V electronic type.
 - .3 Set-point adjustment for thermostats in public spaces is to be concealed behind cover. Set-point adjustment for other thermostats is to be accessible through cover.
 - .4 Covers are to be removable, tamper-proof covers with temperature set-point and thermometer displays.
 - .5 Guards for thermostats are to be clear, ventilated acrylic covers with Allen key locking hardware.
 - .6 Thermostats to be Distech Controls Allure EC-Smart-Comfort series or equivalent. C/W dedicated rotary knob for setpoint offset and override occupancy push-button.
- .15 Humidistats:
 - .1 Direct or reverse acting (to suit system), proportional type, adjustable humidity controllers, each corrosion resistant, suitable in all respects for the application and complete with a nylon element, replaceable cartridge type air filter, internally adjustable limit stops for maximum and minimum settings, a cover, and required mounting and connection accessories.
 - .2 Wall mounting humidistats are to be complete with a tamper-proof display type cover.
- .16 Hardware to permit building automation system control and monitoring of input/output points in accordance with Section 25 05 02 – Building Automation System, points schedule, and drawing control diagrams and operation sequences. All such hardware is to be suitable in all respects for interface with the building automation system.

2.04 System Wiring Materials

- .1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in appropriate Section(s) of Electrical Work specification.

3 Execution

3.01 General Re: Installation of Controls

- .1 Provide complete systems of control and instrumentation to control and supervise building equipment and systems in accordance with this Section and drawings.
- .2 Control systems are to generally be as indicated on drawing control diagrams and are to have all the elements therein indicated or implied.
- .3 Control diagrams show only the principal components controlling the equipment and systems. Supplement each control system with all relays, transformers, sensors, etc., required to enable each system to perform as specified and to permit proper operation and supervision.

3.02 Supply of Automatic Control Valves and Operators

- .1 Unless otherwise specified, supply required automatic control valves. Hand valves to appropriate piping trades at site in locations they are required for installation as part of piping work. Ensure each valve is properly located and installed.
- .2 Provide an operator for each valve.

3.03 Installation of Thermostats

- .1 Unless otherwise noted, provide required thermostats.
- .2 Provide a ventilated clear acrylic cover for each thermostat located in finished areas, and a wire type guard for each thermostat located in unfinished areas and in areas such as mechanical rooms where thermostat is subject to damage.
- .3 Unless otherwise indicated, mount room thermostats 1.5 m (5 ft) above finished floor level. Thermostats intended to be used by building occupants in a barrier-free path of travel to be mounted at 1.2 m (4 ft). Confirm exact location of all thermostats prior to roughing-in.
- .4 Provide stand-off mounting and an insulated sub-base for thermostats on outside walls.
- .5 Perform control wiring associated with installation of electric or electric-electronic thermostats.

3.04 Installation of Control System Components

- .1 Provide required control system components and related hardware. Refer to drawing control diagrams and sequences.
- .2 Where components are pipe, duct, or equipment mounted supply components at proper time, coordinate installation with appropriate trade, and ensure components are properly located and mounted.

3.05 Control Wiring

- .1 Perform required control wiring work for control systems except:
 - .1 power wiring connections to equipment and panels, except as noted below;
 - .2 control wiring associated with mechanical plant equipment and systems whose control is not part of work specified in this Section;
 - .3 starter interlock wiring.
- .2 Except as specified below, install wiring in conduit. Unless otherwise specified, final 600 mm (2 ft) connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.
- .3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.
- .4 Wiring work is to be in accordance with certified wiring schematics and instructions, and wiring standards specified in appropriate Sections of Electrical Work Specification.

3.06 Identification and Labelling of Equipment and Circuits

- .1 Refer to identification requirements specified in Section 20 05 00 – Common Work Results for Mechanical.
- .2 Identify equipment as follows:

- .1 enclosures and components: engraved laminated nameplates with wording listed and approved prior to manufacture of nameplates;
- .2 wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings.

3.07 Testing, Adjusting, Certification, Start-Up, and Training

- .1 When control work is complete, check installation of components and wiring connections, make any required adjustments, and coordinate adjustments with personnel doing HVAC testing, adjusting, and balancing work.
- .2 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .3 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .4 Include for one (1) full, 8 hour days on-site operation demonstration and training sessions. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.
- .5 Include for 2 follow-up site training and troubleshooting visits, one 6 months after Substantial Completion and other at end of warranty period, both when arranged by Owner and for a full, 8 hour day to provide additional system training as required, and to demonstrate troubleshooting procedures.

End OF Section

1 General

1.01 Abbreviations and Definitions

.1 Abbreviations used in this Specification are as follows:

- .1 BAS building automation system;
- .2 DDC direct digital controls;
- .3 LAN local area network;
- .4 PC personal computer.

1.02 Submittals

.1 Submit shop drawings/product data sheets for BAS components. As a minimum, submit the following:

- .1 BAS network architecture, including modes and interconnections;
- .2 systems schematics, sequences, and flow diagrams;
- .3 points schedule for each point in BAS, including point type, object name, expanded ID, display units, controller type, and address;
- .4 samples of graphic display screen types and associated menus;
- .5 detailed Bill of Materials for each system or application, identifying quantities, part numbers, descriptions, and optional features;
- .6 control damper schedule including a separate line for each damper and a column for each of damper attributes including code number, fail position, damper type, damper operator, duct size, damper size, mounting and actuator type;
- .7 control valve schedules including a separate line for each valve and a column for valves as for control dampers;
- .8 room schedule including a separate line for each HVAC terminal unit indicating type, location and address;
- .9 details of BAS interfaces and connections to other systems;
- .10 product data sheets or marked catalogue pages including part number, photograph and description for BAS hardware and software.

1.03 Closeout Submittals

- .1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.
- .2 Record "as-built" drawings are to include:
 - .1 schematic outline of BAS for quick reference of overall system scope;
 - .2 adequate record of work as installed, including locations and routing of system wiring.
- .3 O&M Manual is to include:
 - .1 hardware specification manual which gives a functional description of hardware components;

- .2 operator's manual which outlines concise instructions for operation of system and an explanation and recovery route for system alarms;
- .3 engineering manual which outlines and defines system set-up, definition and application;
- .4 data manual which indicates applications data programmed into system;
- .5 system software documentation.

1.04 Description of the Building Automation System

- .1 Provide complete electronic controls for operation and monitoring of new equipment through the existing Building Automation System. Provide extension to existing BAS System to integrate new equipment controls, including displays, programs and graphics for fully functional system. All new equipment to be provided with new control devices as noted in this specification, Owner's BAS Master Specifications, and Owner's s BAS System Integration Specifications.
- .2 BAS is to include, but not be limited to, following:
 - .1 network of standalone network automation engine(s);
 - .2 network of field equipment controllers;
 - .3 input/output modules;
 - .4 local display devices;
 - .5 distributed user interfaces;
 - .6 network processing, data storage and communication equipment;
 - .7 all other components required for a complete and operating BAS.
- .3 Refer to attached Owner Master Specifications and System Integration Specifications for additional information.

1.05 Quality Assurance

- .1 BAS hardware and software is to be installed by experienced personnel employed and trained by manufacturer/supplier of field equipment controllers. System wiring is to be installed by journeyman electricians or under direct on-site supervision of journeyman electricians.

2 Products

2.01 General Re: Building Automation System

- .1 Control system components (field devices) other than those specified in this Section are generally specified in Section 25 05 01 – Automatic Control Systems. Components factory installed with equipment or supplied with equipment are specified in mechanical work Sections with equipment.
- .2 BAS specified in this Section is an expandable DDC building automation system in accordance with drawing control diagrams and sequences, and points lists.
- .3 Approved vendor:
 - .1 Energy Controls Inc.
565 Trillium Drive, Unit 10

Kitchener, ON

519-893-2638

Jim Grieve (jim@energycontrols.ca)

2.02 BAS Architecture

- .1 BAS is to be based industry standard Ethernet TCP/IP communications protocol. Where used, LAN controller cards are to be standard "off-the-shelf" products available through normal PC vendor channels. BAS is to be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication. BAS is to be compatible with other enterprise-wide networks, and where indicated, BAS is to be connected to the enterprise network and share resources with it by way of standard networking devices and practices.
- .2 Network automation engines are to provide supervisory control over control network and are to support BACnet Standard MS/TP bus communication protocol (ASHRAE SSPC-135, Clause 9). Control networks are to provide either a "peer-to-peer", master-slave, or supervised token passing communications and are to operate at a minimum communication speed of 9600 baud. DDC controllers are to reside on control network.
- .3 BAS is to include appropriate hardware and software to allow BACnet bi-directional data communications between BAS and building equipment/system control panels. BAS is to receive, react to, and return information from connected equipment and systems. Data required by application is to be mapped into automation engine's data base and is to be transparent to operator. Point inputs and outputs from building equipment/system control panels is to have real-time interoperability with BAS software features such as control software, energy management, custom process programming, alarm management, historical data and trend analysis, totalization, and local area network communications.

2.03 Field Equipment Controllers

- .1 Each field equipment controller is to be a fully user programmable BACnet Testing Labs (BTL) certified and labelled digital controller that communicates via BACnet MS/TP protocol. Each controller is to be housed in a plenum rated plastic housing with removable base to permit pre-wiring of analog and binary input/output field points without controller in place.
- .2 Each controller is to employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences, and is to be factory programmed with a continuous adaptive tuning algorithm that sense changes in physical environment and continually adjusts loop tuning parameters appropriately.
- .3 Each field equipment controller is to:
 - .1 include troubleshooting LED's to identify following conditions:
 - .1 Power On;
 - .2 Power Off;
 - .3 Download or Start-Up In Progress-Not Ready For Normal Operation;
 - .4 No Faults;
 - .5 Device Fault;
 - .6 Field Controller Bus-Normal Data Transmission;
 - .7 Field Controller Bus-No Data Transmission;

- .8 Field Controller Bus-No Communication;
- .9 Sensor Actuator Bus-Normal Data Transmission;
- .10 Sensor Actuator Bus-No Data Transmission;
- .11 Sensor Actuator Bus-No Communication.
- .2 support universal inputs, configured to monitor any of following:
 - .1 analog input, voltage mode;
 - .2 analog output, current mode;
 - .3 analog input, resistive mode;
 - .4 binary input, dry contact maintained mode;
 - .5 binary input, pulse counter mode.
- .3 support binary inputs configured to monitor either of following:
 - .1 dry contact maintained mode;
 - .2 pulse counter mode.
- .4 support analog outputs configured to output either of following:
 - .1 analog output, voltage mode;
 - .2 analog output, current mode.
- .5 support binary outputs, 24 VAC Triac;
- .6 support configurable outputs capable of following:
 - .1 analog output, voltage mode;
 - .2 binary output mode.
- .7 have ability to reside on a master-slave/token-passing field controller bus supporting BACnet standard protocol as follows:
 - .1 support communications, including input/output communications between field controllers and network automation engines;
 - .2 support a minimum of one hundred input/output modules and field equipment controllers in any combination;
 - .3 operate at a maximum distance of 4560 m (15,000 ft) between field controller and furthest connected device.
- .8 have ability to monitor and control a network of sensors and actuators over a master-slave/token-passing sensor-actuator bus supporting BACnet standard protocol as follows:
 - .1 bus is to support a minimum of ten devices per trunk;
 - .2 bus is to operate at a maximum distance of 365 m (1200 ft) between field controller and furthest connected device.

- .9 capability of executing complex control sequences involving direct wired input/output points as well as input and output devices communicating over field controller bus or sensor-actuator bus;
- .10 support, but not limited to, following:
 - .1 hot water, chilled water/central plant applications;
 - .2 custom air handling units for special applications;
 - .3 terminal units;
 - .4 special programs as required for systems control.
- .11 support a password protected local controller LCD back-lit display with 6 key keypad as an integral part of field controller or as a remote device communicating over sensor-actuator bus to permit user to view monitored points without logging into system, and to view and change set-points, modes of operation, and parameters.

2.04 Input/Output Modules

- .1 Input/output modules to facilitate additional inputs and outputs for use in field equipment controllers are to be similar to field equipment controllers but less display and with a minimum of 4 and a maximum of 17 points.

2.05 System Configuration Tools

- .1 System configuration tool is a software package supplied with BAS to enable a computer platform to be used as a stand-alone engineering configuration tool for a network automation engine and to permit programming of field equipment controllers. Configuration tool is to provide an archive database for configuration and application data and is to have same look and feel at user interface regardless of whether configuration is being done online or offline. Additional features and characteristics are as follows:
 - .1 tool is to include:
 - .1 basic system navigation tree for connected networks;
 - .2 integration of system enabled devices;
 - .3 customized user navigation tress;
 - .4 point naming operator parameter setting;
 - .5 graphic diagram configuration;
 - .6 alarm and event message routing;
 - .7 graphical logic connector tool for custom programming;
 - .8 downloading, uploading, and archiving databases.
 - .2 tool is to have capability to automatically discover field devices on connected buses and networks;
 - .3 tool is to be capable of configuring from a library of standard applications, simulating to verify applications, and commissioning field equipment controllers and field devices;

- .4 tool is to be complete with a Bluetooth Wireless Technology wireless access point to enable a wireless enabled portable computer to make a temporary Ethernet connection to automation network.
- .2 Bluetooth Wireless Technology converter is to provide temporary wireless connection between sensor-actuator bus or field-controller bus and a wireless enabled portable computer. Converter is to be powered through a connection to either sensor-actuator bus or the field-controller bus and is to support downloading and troubleshooting field equipment controllers and field devices from portable computer over wireless connection. Converter is to be complete with LED indicators for following conditions:
 - .1 Power: On/Off;
 - .2 Fault: Fault/No Fault;
 - .3 SA/FC Bus: Bus Activity/No Bus Activity;
 - .4 Bluetooth: Bluetooth Communication Established/Bluetooth Communication Not Established.

2.06 Wiring Materials

- .1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in Division 26 – Electrical.

3 Execution

3.01 General Re: Installation of the BAS

- .1 Provide complete electronic controls for operation and monitoring of new equipment through the existing Building Automation System and in accordance with requirements of this Section of the Specification, Section 25 05 01 – Automatic Control Systems, drawings, and the input/output points list(s). Provide extension to existing BAS System to integrate new equipment controls, including displays, programs and graphics for fully functional system. All new equipment to be provided with new control devices as noted in this specification, Owner's BAS Master Specifications, and Owner's s BAS System Integration Specifications.
- .2 Unless otherwise specified, perform BAS work in accordance with system manufacturer's instructions.

3.02 Installation of Direct Digital Control System Components

- .1 Provide required direct digital control hardware, software, accessories, and wiring to integrate with existing building BAS. Refer to drawing control diagrams and sequences, points list(s), and Section 25 05 01 – Automatic Control Systems.
- .2 DDC work is to be performed by skilled technicians, properly trained and are qualified for this work.
- .3 Materials and equipment used are to be standard components, regularly manufactured for this and/or other systems, and not custom designed especially for this project. Systems and components are to have been thoroughly tested and proven in actual use.
- .4 System is to be modular, permitting expansion by adding hardware and software without changes in communication or processing equipment.
- .5 Provide new communications bus as required complete with required ancillaries. Connect and extend existing communications bus.
- .6 Provide 1 supervisory controller (SC) per cabinet fan (air handler). Provide necessary field equipment controllers (FEC).

- .7 Provide necessary quantity of SC to accomplish requirements of this specification, and to minimize number of mechanical systems that would be inoperative in event of a FEC failure. A maximum of 2 major mechanical systems are to be controlled by 1 FEC.
- .8 Indicate via number, and systems controlled by SC and FEC. Indicate via a lamacoid label mounted inside panel the identification number of electrical panel supplying power to SC and FEC.
- .9 Submit schedule(s) of input/output points to the Consultant for review. Directly connect each SC and FEC to point devices in accordance with control diagrams and schedule of miscellaneous control points as shown on drawings. Sensor wires for each analogue input are to be 18 AWG twisted-shielded cable. Other types of wire required are to be as recommended by system supplier.
- .10 Provide required sensors, remote devices, etc., and required interface accessories. Mount duct and/or plenum sensors half-way across duct or plenum.
- .11 Supply and turn over to the Consultant prior to application for a Certificate of Substantial Performance of the Work, reports to be used in assisting Owner in defining and debugging DDC programs. These reports are to consist, as a minimum, of following:
 - .1 process control language (PCL) logs;
 - .2 control loop logs;
 - .3 PCL master point.
- .12 Submit Point Data Input forms to Consultant that Owner will fill out with DDC system supplier's assistance. Input this point data into the system.
- .13 Contacts will be supplied as part of mechanical work or electrical work for alarm and status points for systems and equipment other than building environmental systems and equipment. Connect to DDC system in accordance with point schedule.

3.03 Control Wiring

- .1 Perform required control wiring work for control systems except:
 - .1 power wiring connections to equipment and panels, except as noted below;
 - .2 control wiring associated with mechanical plant equipment and systems whose control is not part of work specified in this Section;
 - .3 starter interlock wiring.
- .2 Except as specified below, install wiring in conduit. Unless otherwise specified, final 600 mm (2 ft) connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.
- .3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.
- .4 Wiring work is to be in accordance with BAS manufacturer's certified wiring schematics and instructions, and wiring standards specified in electrical work Division of this Specification.

3.04 Identification and Labelling of Equipment and Circuits

- .1 Refer to Section 20 05 00 – Common Work Results for Mechanical.
- .2 Identify BAS equipment as follows:

- .1 enclosures: engraved laminated nameplates with lettering such as BAS Panel CP2, or BAS Relays, or BAS E/P Transformers, with all wording listed and approved prior to manufacture of nameplates;
- .2 panel points: a weather-proof input/output layout sheet for each controller with the name of each point connected to controller, and associated wire labelling information;
- .3 wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings;
- .4 interface components: a weather-proof layout sheet clearly illustrating/identifying purpose of each component within enclosure such that an operator or service technician can quickly identify exact use of each relay, transducer, contactor, etc., with each sheet fastened securely to back of enclosure door.

3.05 System Startup

- .1 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .2 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.06 Closeout Activities

- .1 Include for demonstration and training sessions for each of 2 groups of Owner's operating and maintenance personnel as follows:
 - .1 One 4 hour orientation sessions at system manufacturer's office to educate personnel on BAS architecture, hardware, and software, with an overview of BAS operation and capabilities including but not limited to operational programmes, equipment functions (both individually and as part of a total integrated system), BAS commands, advisories, alarms, and appropriate operator intervention required in responding to BAS operation;
 - .2 One 2 hour session at site using BAS for a "hands-on" demonstration of BAS functions and features with instruction regarding chronological flow of information from field devices, contacts and sensors to operator's workstation, an overview of communications network describing interplay between initiating devices, field hardware panels, systems communications, and their importance within operating BAS, and alarm indications and appropriate responses;
 - .3 One 3 hour seasonal (summer-winter) site session to perform additional instruction regarding seasonal changes and how they affect BAS.
- .2 Include for 2 follow-up site training and troubleshooting visits, one 6 months after Substantial Completion and other at end of warranty period, both when arranged by Owner and for a full day to provide additional system training as required.

End of Section



WRDSB BAS Master Sequence of Operations

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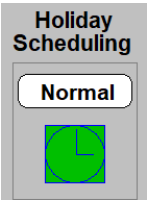
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1. **Integration Requirements**

General Sequence of Global and Local Operation

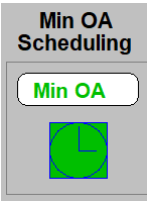
1.1. **Holiday Schedule**

A calendar based schedule that is user adjustable at a global (board wide) or local (site specific) level. Typical entries include the standard board and statutory holidays that apply to the school board: New Year’s Day, Christmas Day, Boxing Day, Christmas Holidays, Canada Day, etc. and are pre-defined at the front end Server Dashboard.



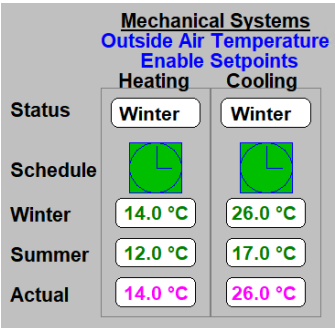
1.2. **Global Ventilation Schedule**

A time of day schedule that is user adjustable at global (board wide) or local (site specific) level. Typical entries include: 7:00 a.m. to 4:00 p.m. Monday to Friday. Outside of this schedule all outdoor air dampers are maintained (spring return / fail) closed when Global Ventilation is disabled.



1.3. **Cooling Enabled Mode**

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the cooling enable mode based on the outdoor air temperature exceeding the threshold. The threshold is further adjusted by a calendar schedule. Typical default values are: 18 °C from May to September, except 21 °C from June to August.



1.4. Heating Enabled Mode

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the heating enable mode based on the outdoor air temperature below the threshold. The threshold is further adjusted by a calendar schedule.

Mechanical Systems		
Outside Air Temperature Enable Setpoints		
	Heating	Cooling
Status	Winter	Winter
Schedule		
Winter	14.0 °C	26.0 °C
Summer	12.0 °C	17.0 °C
Actual	14.0 °C	26.0 °C

1.5. Free Cooling Setpoint Calculation

The average outdoor air relative humidity is sent from the Niagara Server to the Global Input for all schools / Ed Centre where the Free Cooling Setpoint is calculated. Free cool is enabled when $OAT < \text{minimum} (23.5^{\circ}\text{C}, 29.4^{\circ}\text{C} - \Phi/7.43)$ where Φ is the average relative humidity in %RH.

The free cooling signal is 100% when the OAT is more than 2°C below the free cooling setpoint. The free cooling signal decreases towards zero linearly as the outdoor air temperature increases from 2 °C below 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. Minimum outdoor air damper position signal may exceed the free cooling signal. The free cooling signal is still subject to the mixed damper safeties that would keep minimum position during occupied mode. Also the free cooling signal will be at a lower priority than the CO₂ demand ventilation (where applicable) up to 40% outside damper position.

Free Cooling Max	
OatHiDevLo-Hi	FreeClgMaxHi-Lo
-2.0 °C	100 %
0.0 °C	25 %
Group 1	100 %
OARHAvg	75 %RH
Free Cooling Setpoint	19.2 °C
OAT- FreeClgSP (Diff)	-19.4 °C

1.6. Sample Calculations Tables:

1.6.1. Humidity-Limited Free Cooling

The table in Appendix 'A' serve to illustrate the net result of the Free Cooling Setpoint Calculation formula for a given dataset of Outdoor Air Humidity (average relative humidity in %RH) and Outdoor Air Temperatures (OAT in °C)

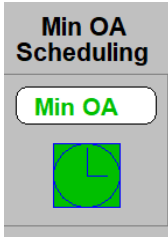
1.6.2. Outside Air Temperature Limit Free Cooling

This table in Appendix 'B' serve to illustrate the net result of the Outdoor Low Limit Calculation formula for a given dataset of Outdoor Air Temperatures (OAT in °C)

The Outdoor Low Limit Calculation is used to restrict the maximum outdoor damper position when the outdoor air temperature is too cold for the proper operation of the mechanical equipment as an additional preventative level of freeze protection.

1.7. Minimum Outdoor Air Enable Time Schedule:

A set of time schedules, one for each of the 4 school board areas are configured (typically from 7:00 a.m. to 4:00 p.m., to send an enable flag to each site to allow outside air mixing dampers to open to minimum position, economizer operation (for required cooling demand) or return air CO₂ (for required ventilation demand).



1.8. Minimum Outdoor Air Mixing Damper Position Setpoint:

A set of Minimum Outdoor Air Position, one for each of the the 4 school board areas are configured to send to each of the sites to send the outdoor air mixing dampers to open to minimum position when the Minimum Outdoor Air Enable Time Schedule is enabled and there are no additional demands for cooling or ventilation are called. Set point to be 5% or minimum permitted by ASHRAE 6.2 Table 6-2 Area Outdoor Air Rate - Educational Facilities at 0.06, 0.12 and 0.18 cfm/ft2 - for occupiable space - no corridors, utility spaces, etc

Area 1 MinOASP **100 %**

1.9. Night Setback Heating Setpoint:

Reset from outdoor air temperature. The setpoint is used as a threshold to determine if the system is to be automatically brought out of an idle night setback mode and into an active heating mode.

Outside Air	NSB SP
0.0 °C	16.0 °C
-20.0 °C	18.0 °C

1.10. BAS Designations:

System Point Nomenclature

Each of the system components are to be named or referenced in the BAS system as per the following table. Consultants/ designers / contractors are to use the same reference designation in schedules / specifications and equipment labels to ensure conformity with control operations, future warranty and maintenance and associated work order systems.

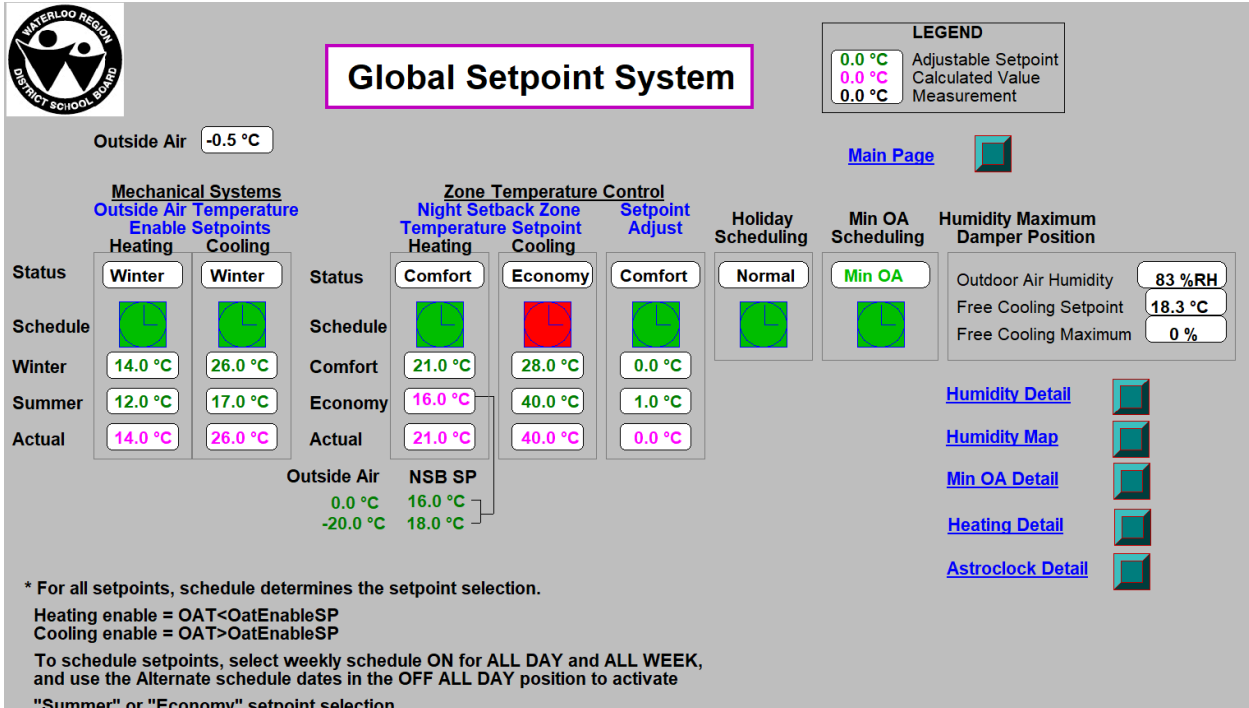
COMPONENT DESCRIPTION	BAS DESIGNATION
Air Handling Unit	AHU
Boiler	B
Bypass Damper	BD
Bypass Box (Dump Box)	BB
Cabinet Heater	CH
Chiller	CHR
Condensing Units / Heat Pump Unit	CU
Cooling Tower	CT
Domestic Hot Water Heater	DHW
Ductless Split	DS
Electric Heater	EH
Energy Recovery Ventilator	ERV
Exhaust Fan	EF
Fan Coil	FC
Gas Fired Heat Pump	GHP
Heat Pumps	HP

Variable Refrigerant Flow Unit	VRF
Heat Recovery Ventilator	HRV
Heating & Ventilation Unit	HV
Heating Ventilation & Air Conditioning Unit	HVAC
Make Up Air Unit	MUA
Multizone Unit	MZ
Outside Lighting	Outside Lighting
Package Cooling Only Unit	AC
Packaged Terminal Air Conditioner	PTAC
Pump or Circulator (Domestic, Storm/Sanitary, Chilled, Heating Water)	P
Radiator	RAD
Radiant Floor Heat	RFH
Radiant Panel	RP
Reheat Coil	RHC
Return Fan	RF
Supply Fan	SF
Unit Heater	UH
Unit Ventilator	UV
Variable Air Volume Damper	VAV
Variable Volume Temperature Damper	VVT
Water Main Auto Flush	WM Auto Flush

2. **Definitions:**

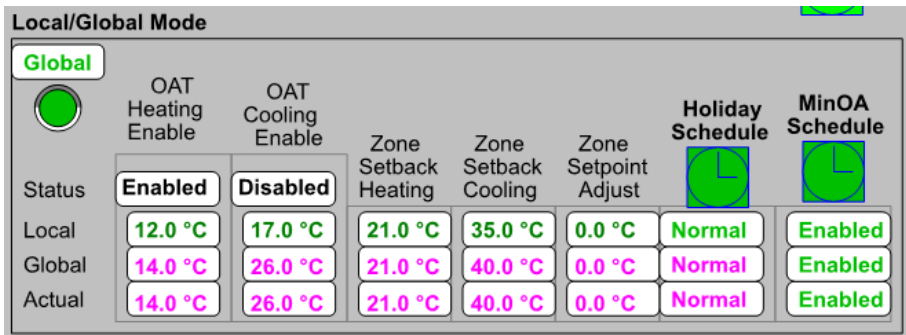
2.1. **Global Functions:**

A set of setpoints and schedules managed by the high level operator from a central server dashboard.



2.2. Local Functions:

A set of setpoints and schedules managed by the high level operator from a site specific dashboard.graphic.



2.3. Local Mode of Operation:

When the local/global flag is set to Local mode, the global setpoints and schedules are ignored and the local setpoints and schedules are used to determine the various enable/disable modes of operation.



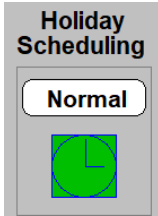
2.4. Global Mode of Operation:

When the local/global flag is set to Global mode, the local setpoints and schedules are ignored and the global setpoints and schedules are used to determine the various enable/disable modes of operation.



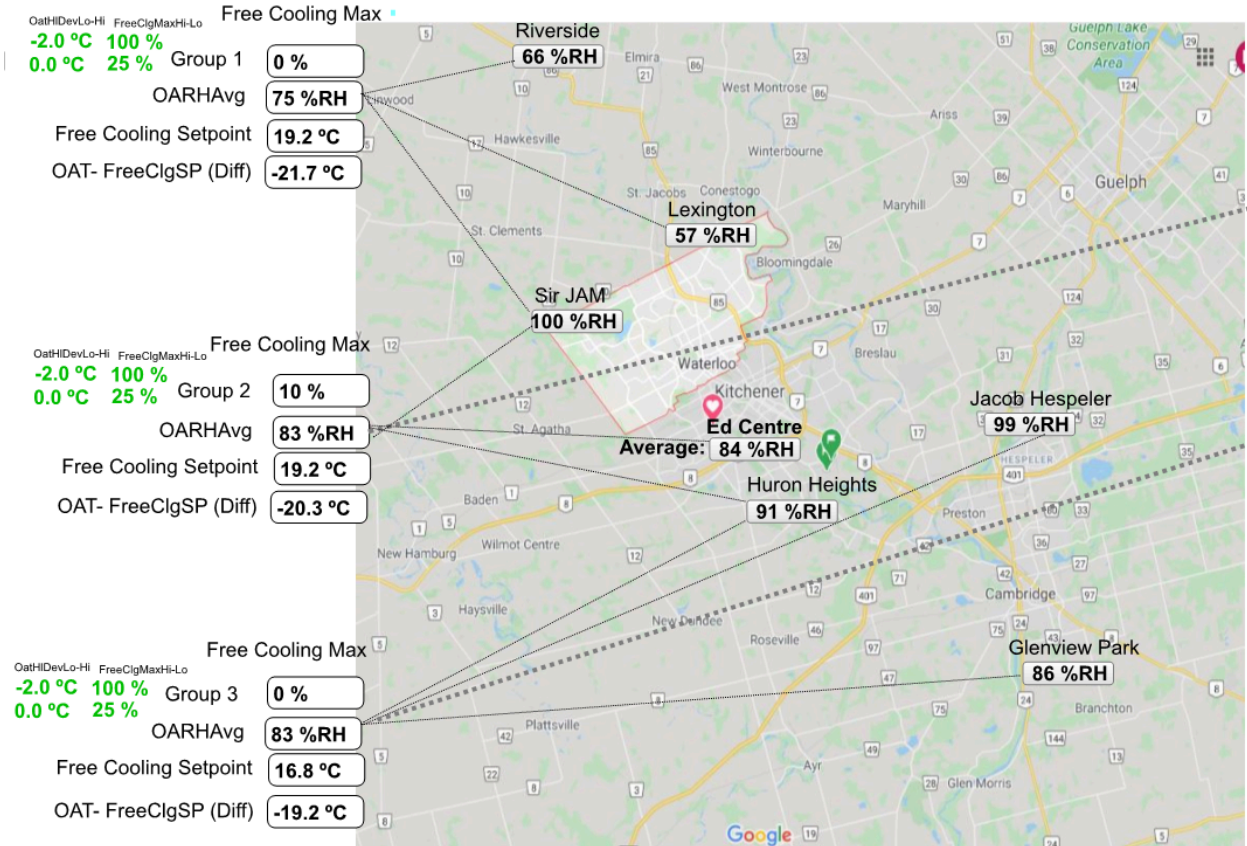
2.5. Server Based Holiday Scheduling

A central master holiday calendar-based schedule overrides the regular time schedule of each system unless exempted on a system-by-system basis.



2.6. Server based Humidity:

Each school is placed into one of three humidity zones when the nearest three outdoor humidity sensors are averaged at the server level and then distributed to each of the three humidity zones.



2.7. Server based Heating Reset Setpoints:

Each school with hot water systems will have a set of outdoor heating reset parameters sent to it based on one of four area locations. These reset parameters are managed by a high level operator from a central server dashboard.

Boiler Reset Parameters				Heating Enable Disable Dates			
Area 1	Morning WarmUp		Night Setback	Heating On Month	Heating On Day	Heating Off Month	Heating Off Day
	OA1 - OA2	HW1 - HW2					
	-5.0 °C	85 °C	MWUHS				
	10.0 °C	50 °C	NSBHWS	10	28	5	10

2.8. Server based Astroclock:

Each school with outdoor lighting will have a set of lighting offset parameters sent to it based on one of four area locations. These parameters will provide an offset (in minutes, typically -15 minutes) to direct the lights off after sunrise and the lights on before sunset.

	Lights Off After Sunrise	Lights On Before Sunset
Area 1	-15 minutes	-15 minutes

2.9. Fire Alarm Sequence of Operation:

On a fire alarm condition, an alarm is generated at the BAS and all supply fans stop (except exhaust fans stay under automatic control) in order to alleviate smoke movement. This is not intended as a safety interlock - only to avoid unnecessary alarms at the BAS. Unless otherwise directed by the local authority having jurisdiction.

2.10. Server based Minimum Outdoor Air Damper Position Setpoint:

Each school will have an minimum outdoor damper position setpoint sent to it based on one of four area locations. These parameters are managed by a high level operator from a central server dashboard.

Min OA Scheduling

Min OA



2.11. Server based Mechanical Systems Outdoor Air Temperature Enable Setpoints:

Each school will have a threshold for enabling mechanical heating or cooling based on outdoor air temperature thresholds. These parameters are managed by a high level operator from a central server dashboard.

Mechanical Systems
Outside Air Temperature
Enable Setpoints

	Heating	Cooling
Status	Winter	Winter
Schedule		
Winter	14.0 °C	26.0 °C
Summer	12.0 °C	17.0 °C
Actual	14.0 °C	26.0 °C

2.12. Server based Zone Temperature Control for Night Setback Heating Setpoints and Setpoint Adjusts:

Each school will have a threshold for enabling the night setback mode when the calculated lowest zone for a particular system falls below threshold. Also the default setpoint can be adjusted to allow for a higher setpoint for the cooling season and holidays. These parameters are managed by a high level operator from a central server dashboard

Zone Temperature Control

	Night Setback Zone Temperature Setpoint Heating	Cooling	Setpoint Adjust
Status	Comfort	Economy	Comfort
Schedule			
Comfort	21.0 °C	28.0 °C	0.0 °C
Economy	16.0 °C	40.0 °C	1.0 °C
Actual	21.0 °C	40.0 °C	0.0 °C

Outside Air	NSB SP
0.0 °C	16.0 °C
-20.0 °C	18.0 °C

2.13. Local System-Based Default Room (Heating) Setpoint

Each air handler and rooftop HVAC system will have an independently adjustable setpoint (in °C) from the system graphic for the user with custodial-level security privileges.

2.14. Local System-Based Time Schedule

Each exhaust fan, outdoor lighting, air handler and rooftop HVAC system will have an independently adjustable time schedule (with hours of the day repeating weekly) from the system graphic for the user with at least custodial-level security privileges and above.

2.15. Outdoor Air Temperature

Each site will have its own dedicated outdoor air temperature sensor wired to an input of a controller. The controller will share the outdoor air temperature with all the other controllers on site for use in various functions which include determining temperature setpoints and enable/disable thresholds for equipment operation.

2.16. Optimized Start Program

Each HVAC system with a time of day schedule will utilize the controller's internal Optimized Start Program to determine the actual start time for the Morning Warm-Up Mode of operation. The controller's Optimized Start Program parameters and inputs are to be configured as follows:

Inputs:

- 1) Outdoor Air Temperature
- 2) Room Temperature or Lowest Zone Temperature (where applicable)
- 3) Local System-Based Time Schedule
- 4) Local System-Based Default Room Heating Setpoint
- 5) Local System-Based Unoccupied Room Heating Setpoint (Distech)

Parameters:

- 1) Maximum Start time offset 105 minutes
- 2) Maximum Temperature offset 2 °C

The Optimized Start Program functions with an algorithm that keeps an internal history of the inputs and its calculated start times that is self-adjusting based on the past performance of the system's Morning Warm up Mode.

2.17. Morning Warmup Mode:

An optimized start, based on the time of day schedule, outdoor air temperature and the lowest indoor zone temperature is provided for heating.

The Global Ventilation Schedule is disabled. The supply fan is on, the return fan is on (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position, heating is enabled at full capacity and the cooling is disabled.

2.18. Rooftop Heating Stage Sequencing:

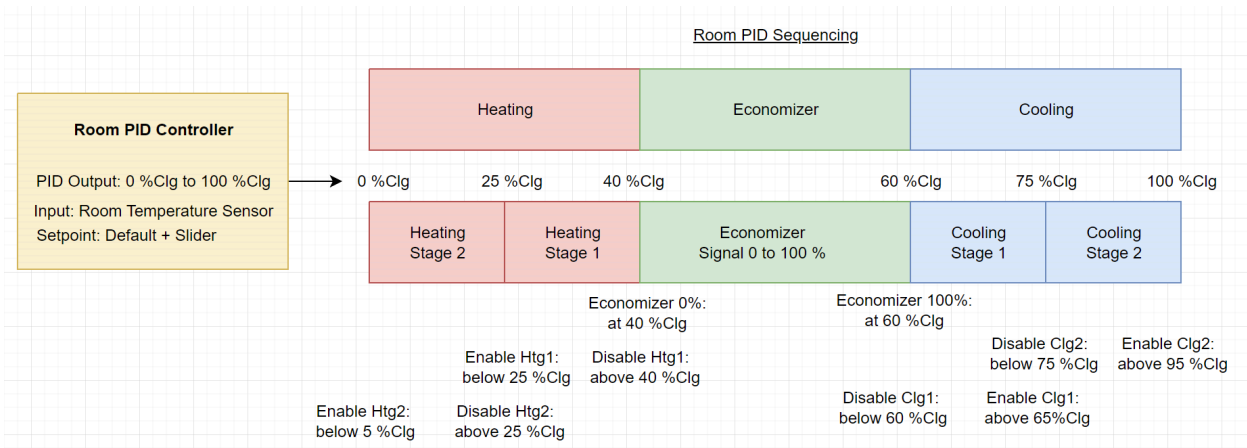
Room Controller PID, (generates a signal based on the room temperature and room setpoint from 0 %Clg to 100 %Clg), typically stage 1 heating is enabled at 25 %Clg PID signal and disabled at 50 %Clg PID signal and stage 2 heating is enabled at 5 %Clg PID signal and disabled at 25 %Clg PID signal.

2.19. Rooftop Economizer Sequencing:

The economizer signal goes from 0 % to 100 % as the Room Controller PID goes from 40 %Clg to 60 %Clg.

2.20. Rooftop Mechanical DX Cooling Stage Sequencing:

Room Controller PID, typically stage 1 cooling is enabled at 75 %Clg PID signal and disabled at 60 %Clg PID signal and stage 2 cooling is enabled at 95 %Clg PID signal and disabled at 60 %Clg PID signal).



3. **Equipment Specific Sequence of Operations:**

3.1. **VVT HVAC Rooftop Unit Sequence of Operations:**

3.1.1. Discretionary Fire Alarm Shutdown Mode:

The supply fan is off, the return fan is off (where applicable) and power exhaust fan is off (where applicable), the outdoor air mixing dampers are in the 0% outdoor air position, heating is disabled and cooling is disabled. The VVT bypass damper is in the 100 % open position. The zone dampers are in the 50 % open position. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal HVAC unit functions are auto restored on relay signal from the fire alarm panel reset.

3.1.2. Software Freeze-stat Shutdown Mode:

The duct/unit mounted supply air temperature sensor acts as a software freeze-stat (triggered below 1 °C after 3 minutes, restored above 5 °C after 3 minutes, and auto reset after 5 minute delay).

3.1.3. Unoccupied Mode:

Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday.

The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes.

The system will cycle between Idle State, Heating State or Pushbutton Override States to meet the demands from each state and return to the Idle State when the demands are satisfied.

3.1.3.1. (Idle State)

The supply fan is off, the return fan is off (where applicable) power exhaust fan is off (where applicable), the Global Ventilation Schedule is disabled, the outdoor air mixing dampers are in the 0 % outdoor air position, heating is disabled and cooling is disabled. The bypass damper is in the 100 % open position. The zone dampers are in the 50 % open position.

3.1.3.2. (Heating State)

System cycles on a call for unoccupied heating. A full call for (all stages or full heat modulation where applicable) heating until setpoint is reached.

The VVT HVAC unit supply air static pressure setpoint is increased by 20 %. Bypass damper(s) and associated zone damper(s) modulate to obtain setpoint.

Unoccupied Heating temperature nominally 16.0 °C space temperature setpoint with an increased space temperature setpoint to 17.0 °C at -10.0 °C Outdoor Air Temperature or lower and 18.0 °C at -20.0 °C Outdoor Air Temperature or lower (each adjustable)

Mechanical Cooling: Disabled

Free Cooling: Disabled

Global Ventilation Schedule: Disabled

3.1.3.3. (Push Button Override State)

The default room temperature setpoint remains unchanged.

Idle state of the unoccupied mode is exited if the override pushbutton is pressed, (for a minimum of 2 seconds) at any room sensor.

The associated system will switch to the Occupied Mode for 2 hours (adjustable).

Free Cooling: Disabled

Mechanical Cooling: Enabled

Global Ventilation: Enabled

The system returns to idle state in the unoccupied mode after the 2 hours after the pushbutton trigger has elapsed.

3.1.4. Morning Warmup Mode:

An optimized start, based on the time of day schedule, outdoor air temperature and the lowest indoor zone temperature is provided for heating.

The Global Ventilation Schedule is disabled. The supply fan is on, the return fan is on (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position, heating is enabled at full capacity and the cooling is disabled.

The VVT bypass damper(s) starts in the 100 % open position. The zone dampers start in the 50 % open position.

The optimized start program is to begin up to 105 minutes (adjustable) before the occupancy schedule to allow for morning warm up to bring the lowest zone temperature up to occupancy setpoint.

Free Cooling: Disabled

Mechanical Cooling: Disabled

Global Ventilation Schedule: Disabled

The system exits Morning Warmup Mode and continues into occupied mode when the lowest indoor zone temperature is warmed up to default room temperature setpoint.

3.1.5. Occupied Mode:

Time of day schedule, which starts the HVAC unit(s) along with an Optimum Start program usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule, Standby Occupancy Mode or Unoccupied Mode.

Global Ventilation Schedule is enabled.

HVAC unit fan status confirmed by current sensing device(s) or VFD feedback.

Fan operation: The supply fan and return fan (where applicable) run continuously.

Room heating temperature setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)

Room Free Cooling Enabled temperature setpoint nominal 22.5 °C +/-1.0 °C

Room mechanical cooling temperature setpoint nominal 24.5 °C +/- 1.0 °C (adjustable)

Global Ventilation Schedule: Enabled

3.1.6. Standby Occupancy Mode:

Time of day schedule starts the HVAC unit(s) usually between 4:00 p.m. and 11:00 p.m. Monday to Friday.

Minimum outdoor air is set to zero when the global ventilation schedule is off.

Fan operation: Supply fan and return fan (where applicable) runs only on a call from heating or cooling.

Ventilation normally set to zero (with a future provision to adjust).

Room heating temperature setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)

Room Mechanical Cooling temperature setpoint nominal 24.5 °C +/- 1.0 °C (adjustable)

Free Cooling: Disabled

Global Ventilation Schedule: Disabled

3.1.7. Zone Damper:

The room sensor modulates the zone damper between minimum and maximum settings to maintain (Occupied, Standby, or Unoccupied) Mode temperatures.

The setpoint is adjustable at the sensor.

The control is reverse acting when the supply temperature is more than 1 °C above room temperature and direct acting when the supply air temperature is more than 1 °C below room temperature.

If the system mode is different from the zone mode (e.g. system is in heating mode but zone requires cooling), the zone damper closes to a reduced minimum position to minimize overheating/overcooling.

A minimum of 5 minutes to changeover between Heating to Cooling Modes is required.

3.1.8. System Heating/Cooling Decision Process:

3.1.8.1. Enable Criteria:

The system mode is determined by the number of zones that deviate by 1.2 °C from their respective zone heating/cooling setpoints. The number of zones is "weighted" by the deviation from setpoint. If the total number of zones requesting heating outnumber (or are equal to) the total number of zones requesting cooling the system will go to Heating Enabled Mode and in reverse for Cooling Enabled Mode.

Once in Heating Enabled Mode or Cooling Enabled Mode, the reference zone becomes the zone of greatest call. The system will lock-in the selected mode until all zones are satisfied. If all zones are not satisfied within 20 minutes (60 minutes if all zones are in the same mode) the system will "unlock" and enable Forced Ventilation Mode.

The outdoor air temperature determines the heating or cooling priority.

3.1.8.2. Heating Enabled Mode

In Heating Enabled Mode, the highest priority zone calling for heating is given first priority. If there is any zone calling for cooling, this is given second priority.

3.1.8.3. Cooling Enabled Mode

In the Cooling Enabled Mode, the highest priority zone calling for cooling is given first priority. If any zone is calling for heating, this is given second priority.

3.1.8.4. Default Ventilation Mode

If there is neither a call for cooling or heating, the system is returned to the Ventilation Sequence

3.1.8.5. Forced Ventilation Mode

Every 20 minutes if the system is not satisfied (and 60 minutes if all zones are in the same mode) the system is switched to ventilation mode for 5 minutes

3.1.9. Ventilation Lockout (Sequence):

When the ventilation lockout switch, usually located in the Custodial Office, is engaged, all outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode of operation.

3.1.10. Heating Sequence:

3.1.10.1. Outdoor Air Temperature used to determine Heating Enable Mode:

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the heating enable mode based on the outdoor air temperature below the threshold. The threshold is further adjusted by a calendar schedule.

Typical default values are: 16 °C from September to May and 5 °C from June to August.

3.1.10.2. Default Setpoint:

When the Heating Mode is active, the default room temperature setpoint remains unchanged.

3.1.10.3. Call for Heating:

Mechanical heating is used until the heating calls (from room controller PID or Night Setback thresholds) are satisfied.

If the total number of zones requesting heating outnumber (or are equal to) the total number of zones requesting cooling, the system will go into Heating Mode.

For Modulating Burners, (where applicable) 0 % signal (0 Volts) heating discharge temperature setpoint is at minimum discharge temperature (typically set on the rooftop unit to 17.0 °C). A 100 % signal (10 Volts) heating discharge temperature setpoint is at maximum discharge temperature setpoint (typically set on the rooftop unit to 35 °C).

Hydronic

For Heating Valve, (where applicable) 0 % signal (10 Volts) closes the heating valve. A 100% signal (below 2 Volts) opens the heating valve.

Radiation Zone

Where there is a zone served by radiation, the radiation valve opens (where applicable) and is to be substituted as the first stage of heating.

Supplemental Electric Space Heating

Where there is a zone supplemented by electric space heating, the electric heater starts (where applicable) and is to be utilized as the second stage of heating.

3.1.11. Cooling Sequence:

3.1.11.1. Outdoor Air temperature used to determine cooling enable mode:

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the cooling enable mode based on the outdoor air temperature exceeding the threshold. The threshold is further adjusted by a calendar schedule. Typical default values are: 18 °C from September to May and 21 °C from June to August.

3.1.11.2. Default Cooling Setpoint:

When the cooling enable mode is active, the default room temperature setpoint is raised by 3 °C.

3.1.11.3. Call for Cooling:

When Free Cooling is available, and a demand for cooling is in place, free cooling will be used first, and if the demand for cooling is still in place, mechanical cooling will be used until the cooling calls (from room controller PID) are satisfied.

If the total number of zones requesting cooling outnumber the total number of zones requesting heating, the system will go into cooling mode.

3.1.12. Reference Zone Sequence:

Once in heating or cooling mode, the reference zone becomes the zone with the greatest call. The system mode will lock-in in the selected mode until all zones are satisfied.

3.1.13. Forced Vent Sequence

When Global Ventilation Schedule is Enabled: If any zone is deprived of ventilation air for more than 20 minutes, the system will unlock and go into Forced Ventilation Mode for 5 minutes, and then reselect the required mode of operation.

- 3.1.14. Slave Zones:
Zones designated as slave zones without cooling (typically corridors) cannot request heating or cooling, but will utilise heating when available. Cooling is not available and locked out for slave no-cooling zones. Zones designated as slave zones with cooling (typically a retrofitted work room off a classroom) cannot request heating or cooling but will utilize heating or cooling when available. Slave zones with cooling are to be minimized.
- 3.1.15. System Heating Control:
Stage 1 and Stage 2 heating are controlled from the reference zone as follows:
Reference Zone Call for Heating
Stage 1 On 1.0 °C
Stage 1 Off 0.5 °C
Stage 2 On 1.5 °C
Stage 2 Off 1.0 °C
Modulation: Heating is modulated (where applicable).
- 3.1.16. System Cooling Control:
Stage 1 and Stage 2 cooling are controlled from the reference zone as follows:
Reference Zone Call for Cooling
Stage 1 On 1.2 °C
Stage 1 Off 0.5 °C
Stage 2 On 1.5 °C
Stage 2 Off 0.9 °C
Modulation: Cooling is modulated (where applicable).
- 3.1.17. Bypass Operation:
The supply air static pressure sensor modulates the bypass damper between minimum and maximum settings to maintain supply static pressure setpoint. Reduce the supply air static pressure setpoint during both Default and Forced Ventilation modes, typically 10 Pa for acoustic noise reduction. During Unoccupied Mode setback, increase supply air static pressure setpoint, typically 120 % of regular setpoint.
- 3.1.18. Ventilation Sequence:
The system operates in ventilation mode (no heating or cooling) under the following conditions: No zones are calling for heating or cooling. System is switching between heating and cooling (the system operates in ventilation mode for 5 minutes). One or more zones have been operating at a reduced minimum position for more than 20 minutes (system operates in Forced Ventilation Mode for 5 minutes).
- 3.1.19. Economizer Operation (and CO2 Demand Control Ventilation) :
- 3.1.19.1. During Occupied Mode, economizer operation will be substituted for first stage mechanical cooling when the outdoor air temperature and relative humidity are below the Free Cooling Setpoint Sequence of Operation. If the outdoor air temperature is below this free cooling setpoint the mixing dampers will be modulated open on a call for cooling to provide 'free' cooling.
- 3.1.19.2. Minimum outdoor air damper position signal may exceed the economizer signal. A typical value for minimum outdoor air damper position is 5 % outdoor air, (0 % when an associated stand alone ERV is present) which can vary based on use case of the occupied space based on ASHRAE 62.1 net occupiable floor area outdoor air rate.
- 3.1.19.3. For HVAC units with power exhaust, the exhaust fan runs when the outdoor air damper is more than 50 % open.
- 3.1.19.4. During morning warm-up, the outdoor air minimum position is set to zero.
- 3.1.19.5. During Unoccupied Mode and Standby Occupancy Mode, free cooling is unavailable.
- 3.1.19.6. During Occupied Mode, If the outdoor air temperature and relative humidity are above the Free Cooling Setpoint Sequence of Operation, the mixing dampers will be set to the minimum outdoor air threshold unless otherwise required under ASHRAE 62.1 Ventilation Rate Procedure - net occupiable floor area outdoor air rate (w/ CO2 demand controlled ventilation reset).
- 3.1.19.7. Each return air duct-mounted or space mounted CO2 sensor acts as a high limit and will increase the amount of minimum outdoor air, to a maximum of 40% outdoor air as the CO2 level increases from 1100 ppm (1000 ppm to 1200 ppm over a ramped 15 minute period).
- 3.1.19.8. CO2 levels are automatically logged at 10 minute intervals (adjustable).
- 3.1.20. Additional Rooms Partition Switch
Any additional room(s) (ie. Music Rooms) that are separated by a partition wall, will disable mechanical cooling (where applicable) for the associated units that serve the additional room(s). If the Music Room wall is open to the Gym, mechanical cooling serving the Music Room is disabled. Partition switch and lamacoid label to be provided above Music Room Sensor by the Building Automation Contractor. Label to read "No Cooling when Partition is Open to Gym".

- 3.1.21. Limits and Safeties:
- 3.1.21.1. The maximum outdoor air damper position is limited based on the outdoor air temperature to prevent excessively low supply air temperature. At -15°C or below, outdoor air temperature, the maximum outdoor air damper position will be 0% open and at 10°C outdoor air temperature, the maximum outdoor air damper position will be 100%.
- 3.1.21.2. The maximum outdoor air damper position is limited based on the outdoor air temperature to prevent excessively high supply air temperature. At 30°C outdoor air temperature and above, the maximum outdoor air damper position will be 0% open and at 10°C outdoor air temperature, the maximum outdoor air damper position will be 100%.
- 3.1.21.3. The mixed air temperature sensor acts as a low limit to ensure temperature does not fall below setpoint (typically 11 °C). In applications where the mixed air sensor is located after the DX cooling coil, the setpoint is reduced (to typically 5 °C) when DX cooling is enabled.
- 3.1.21.4. The duct mounted supply air temperature sensor acts as a high limit for each stage of heating (for stage 1: disable above 60°C , and enable below 50°C, for stage 2: disable above 55°C and enable below 45°C) and a low limit for each stage of cooling (for stage 1: disable DX1 below 5°C and enable DX1 above 10 °C, for stage 2: below 8 °C disable DX2 and above 13°C enable DX2).
- 3.1.21.5. The supply air temperature sensor acts as a software freezestat (triggered below 1 °C for 1 minute, restored above 5 °C for 1 minute), auto reset after 5 minute delay.
- 3.1.21.6. The supply fan has a delay-off time of 90 seconds.
- 3.1.21.7. The DX cooling has a minimum-off time of 5 minutes.
- 3.1.21.8. DX cooling is disabled when the outdoor air temperature is below global DX disable setpoint or when fan is off.
- 3.1.21.9. Gas heating is disabled when the outdoor air temperature is above the global heating disable setpoint or when the fan is off.
- 3.1.21.10. Stage 1 gas heating (where applicable for units with multiple stages of heating) has a minimum run time of 3 minutes.
- 3.1.21.11. During Default and or Forced Ventilation Modes, if the supply air temperature falls below 15 °C for more than two minutes, stage 1 heating will turn on until supply air temperature exceeds 25 °C (to improve comfort).
- 3.1.21.12. The default zone setpoint is increased by 3°C when mechanical cooling is enabled (providing heating is disabled). The standard mechanical cooling setpoint will be limited to a (minimum of 23.5 °C - adjustable).
- 3.1.21.13. When the ventilation lockout switch (usually located at the custodial office) is engaged, the outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode.
- 3.1.21.14. Minimum outdoor air is provided when enabled by the Global Ventilation Schedule.
- 3.1.21.15. The return air carbon dioxide sensor acts as a high limit to increase the amount of minimum outdoor air from 0 to 40 % as the reading increases from 1000 ppm to 1200 ppm.
- 3.1.21.16. Cooling cannot turn on until heating has been off for a minimum of 5 minutes.
- 3.1.21.17. During Occupied Mode, and the outdoor air is above -1°C, heating stage 2 (where applicable) has a delay-on time of 15 minutes, except when the outdoor air temperature is below -3°C with a +2°C deadband.
- 3.1.21.18. Minimum outdoor air is set to zero when the Global Ventilation Schedule is off.

- 3.1.22. Alarms:
- An alarm will be generated upon the following conditions:
- 3.1.22.1. Fan status does not match the start/stop signal.
- 3.1.22.2. Mixed air temperature too high alarm, (triggered above 50 °C and restored below 48 °C) or too low alarm (triggered below 5 °C and restored above 7°C). Low mixed air temperature alarm set to lower thresholds when Mixed Air Temperature sensor is installed after the DX/cooling coil.
- 3.1.22.3. Supply air temperature too high alarm (triggered above 65 °C and restored below 63 °C) or too low alarm (triggered below 5 °C and restored above 7 °C).
- 3.1.22.4. Space temperature too high alarm (triggered above 42 °C and restored below 40 °C) for non-cooling systems, (triggered above 38°C and restored above 36°C) for cooling systems.
- 3.1.22.5. Space temperature too low alarm (triggered below 14 °C and restored above 16 °C).
- 3.1.22.6. Supply air static pressure too low alarm (below 5 Pa and restored below 15 Pa) or too high alarm (above 240 Pa and restored below 230 Pa), with a 30 minute delay.
- 3.1.22.7. Weekly fan runtime limit exceeded.
- 3.1.22.8. Return air CO₂ too high alarm (triggered above 1700 ppm and restored below 1650 ppm) or too low alarm (triggered below 250 and restored above 300 ppm) with a 15 minute delay.
- 3.1.22.9. Software freezestat tripped.

3.2. Single Zone HVAC Rooftop Sequence of Operations: (with Heating, Ventilating and Mechanical Cooling)

3.2.1. Discretionary Fire Alarm Shutdown Mode:

The supply fan is off, the return fan is off (where applicable) and power exhaust fan is off (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position, heating is disabled and cooling is disabled. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal HVAC unit functions are auto restored on relay signal from the fire alarm panel reset.

- 3.2.2. Freeze-stat Shutdown Mode(s):
- 3.2.2.1. Software
The duct/unit mounted supply air temperature sensor acts as a software freeze-stat (triggered below 1 °C after 1 minute delay, restored above 5 °C after 5 minute delay).
- 3.2.2.2. Hard-Wired
In addition BAS monitors status of the duct mounted hard wired freeze-stat (provided by others, where applicable) that shuts down the AHU fan(s) and spring closes the outside air damper(s) if the air temperature leaving the heating coil falls below the freeze-stat setpoint.
- 3.2.3. Unoccupied Mode:
Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday.
The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes.
The system will cycle between Idle State, Heating State and Pushbutton Override States to meet the demands from each state and return to the Idle State when the demands are satisfied.
- 3.2.3.1. (Idle State)
The supply fan is off, the return fan is off (where applicable), the power exhaust fan is off (where applicable), the Global Ventilation Schedule is disabled, the outdoor air mixing dampers are in the 0 % outdoor air position, heating is disabled and cooling is disabled.
- 3.2.3.2. (Heating State)
System cycles on a call for unoccupied heating (which is triggered by the System Minimum Zone Temperature falling below the Unoccupied Heating Room Setpoint).
Supply fan cycles on, associated exhaust or return fan cycles on (where applicable).
A full call for (all stages or full heat modulation where applicable) heating until setpoint is reached.
For modulating burners, (where applicable) 0 % signal (0 Volts) heating discharge temperature setpoint is at minimum discharge temperature (typically set on the rooftop unit to 17 °C). A 100 % signal (10 Volts) heating discharge temperature setpoint is at maximum discharge temperature setpoint (typically set on the rooftop unit to 35 °C).
Unoccupied Heating Room Temperature Setpoint nominally 16.0 °C space temperature setpoint with an increased space temperature setpoint to 17.0 °C at -10.0 °C Outdoor Air Temperature or lower and 18.0 °C at -20.0 °C Outdoor Air Temperature or lower (each adjustable)
Mechanical Cooling: Disabled
Free Cooling: Disabled
Global Ventilation Schedule: Disabled
- 3.2.3.3. (Push Button Override State)
The default room temperature setpoint remains unchanged.
Idle state of the unoccupied mode is exited if the override pushbutton is pressed, (for a minimum of 2 seconds) at any room sensor.
The associated system will switch to the Occupied Mode for 2 hours (adjustable).
Free Cooling: Disabled
Mechanical Cooling: Enabled
Global Ventilation: Enabled
The system returns to idle state in the unoccupied mode after the 2 hours after the pushbutton trigger has elapsed.
- 3.2.4. Morning Warmup Mode:
An optimized start, based on the time of day schedule, outdoor air temperature and the lowest indoor zone temperature is provided for heating.
The Global Ventilation Schedule is disabled. The supply fan is on, the return fan is on (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position, heating is enabled at full capacity and the cooling is disabled.
The optimized start program is to begin up to 105 minutes (adjustable) before the occupancy schedule to allow for morning warm up to bring the lowest zone temperature up to occupancy setpoint.
Free Cooling: Disabled
Mechanical Cooling: Disabled
Global Ventilation Schedule: Disabled
The system exits Morning Warm Up Mode and continues into occupied mode when the lowest indoor zone temperature is warmed up to default room temperature setpoint.
- 3.2.5. Occupied Mode:
Time of day schedule, which starts the unit along with an Optimum Start program usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule, Standby Occupancy Mode or Unoccupied Mode.
Global Ventilation Schedule is enabled.
HVAC unit fan status confirmed by current sensing device(s) or VFD feedback.
Fan operation: The supply fan and return fan (where applicable) run continuously.

Room Heating Temperature Setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)
Room Free Cooling Enabled Temperature Setpoint nominal 22.5 °C +/-1.0 °C
Room Mechanical Cooling Temperature Setpoint nominal 24.5 °C +/- 1.0 °C (adjustable)
Global Ventilation Schedule: Enabled

3.2.6. Standby Occupancy Mode:

Time of day schedule starts the HVAC unit(s) usually between 4:00 p.m. and 11:00 p.m. Monday to Friday.
Minimum outdoor air is set to zero (with future provision to adjust) when the global ventilation schedule is off.
Fan operation: Supply fan and return fan (where applicable) runs only on a call from heating or cooling.
Ventilation normally set to zero (with a future provision to adjust).
Room Heating Temperature Setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)
Room Mechanical Cooling Temperature Setpoint nominal 24.5 °C +/- 1.0°C (adjustable)
Free Cooling: Disabled
Global Ventilation Schedule: Disabled

3.2.7. Ventilation Lockout (Sequence):

When the ventilation lockout switch, usually located in the Custodial Office, is engaged, all outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode of operation.

3.2.8. Heating Sequence:

3.2.8.1. Outdoor Air Temperature used to determine Heating Enable Mode:

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the heating enable mode based on the Outdoor Air Temperature below the threshold. The threshold is further adjusted by a calendar schedule.
Typical default values are: 16 °C from September to May and 5 °C from June to August.

3.2.8.2. Default Setpoint:

When the Heating Mode is active, the default room temperature setpoint remains unchanged.

3.2.8.3. Call for Heating:

Mechanical heating is used until the heating calls (from room controller PID, typically stage 1 heating is enabled at 25 %Ctg PID signal and disabled at 50 %Ctg PID signal and stage 2 heating is enabled at 5 %Ctg PID signal and disabled at 50 %Ctg PID signal or Night Setback thresholds) are satisfied.

For Modulating Burners, (where applicable) 0 % signal (0 Volts) heating discharge temperature setpoint is at minimum discharge temperature (typically set on the rooftop unit to 17 °C). A 100 % signal (10 Volts) heating discharge temperature setpoint is at maximum discharge temperature setpoint (typically set on the rooftop unit to 35 °C).

The room temperature sensor regulates heating output to maintain the occupied heating setpoint. Local setpoint adjustment is provided. The power exhaust fan or return fan (if applicable) cycles based on the rooftop economizer position.

Hydronic

For Heating Valve, (where applicable) 0 % signal (10 Volts) closes the heating valve. A 100% signal (below 2 Volts) opens the heating valve.

Radiation Zone

Where there is a zone served by radiation, the radiation valve opens (where applicable) and is to be substituted as the first stage of heating.

Supplemental Electric Space Heating

Where there is a zone supplemented by electric space heating, the electric heater starts (where applicable) and is to be utilized as the second stage of heating.

3.2.9. Cooling Sequence:

3.2.9.1. Outdoor Air Temperature used to determine cooling enable mode:

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the cooling enable mode based on the Outdoor Air Temperature exceeding the threshold. The threshold is further adjusted by a calendar schedule. Typical default values are: 18°C from May to September-and 21°C from June to August.

3.2.9.2. Default Setpoint:

When the cooling enable mode is active, the default room temperature setpoint is raised by 3 °C.

3.2.9.3. Call for Cooling:

When Free Cooling is available, and a demand for cooling is in place, free cooling will be used first, and if the demand for cooling is still in place, mechanical cooling will be used until the cooling calls (from room controller PID) are satisfied.

The room temperature sensor also modulates the mixing dampers (for free cooling) to maintain the occupied free cooling setpoint.

3.2.10. Ventilation Sequence:

The system operates in ventilation mode (no heating or cooling) under the following conditions: System is switching between heating and cooling

- 3.2.11. Economizer Operation (and CO₂ Demand Control Ventilation) :
- 3.2.11.1. During Occupied Mode, economizer operation will be substituted for first stage mechanical cooling when the outdoor air temperature and relative humidity are below the Free Cooling Setpoint Sequence of Operation. If the outdoor air temperature is below this free cooling setpoint the mixing dampers will be modulated open on a call for cooling to provide 'free' cooling.
- 3.2.11.2. Minimum outdoor air damper position signal may exceed the economizer signal. A typical value for minimum outdoor air damper position is 5 % outdoor air, (0 % when an associated stand alone ERV is present) which can vary based on use case of the occupied space based on ASHRAE 62.1 net occupiable floor area outdoor air rate.
- 3.2.11.3. For HVAC units with power exhaust, the exhaust fan runs when the outdoor air damper is more than 50% open.
- 3.2.11.4. During morning warm-up, the outdoor air minimum position is set to zero.
- 3.2.11.5. During Unoccupied Mode and Standby Occupancy Mode, free cooling is unavailable.
- 3.2.11.6. During Occupied Mode, If the outdoor air temperature and relative humidity are above the Free Cooling Setpoint Sequence of Operation, the mixing dampers will be set to the minimum outdoor air threshold unless otherwise required under ASHRAE 62.1 Ventilation Rate Procedure - net occupiable floor area outdoor air rate (w/ CO₂ demand controlled ventilation reset).
- 3.2.11.7. Each return air duct-mounted or space mounted CO₂ sensor acts as a high limit and will increase the amount of minimum outdoor air, to a maximum of 40 % outdoor air as the CO₂ level increases from 1100 ppm (1000 ppm to 1200 ppm over a ramped 15 minute period).
- 3.2.11.8. Additional Rooms Partition Switch
Any additional room(s) (ie. Music Rooms) that are separated by a partition wall, will disable mechanical cooling (where applicable) for the associated units that serve the additional room(s). If the Music Room wall is open to the Gym, mechanical cooling serving the Music Room is disabled. Partition switch and lamacoid label to be provided above Music Room Sensor by the Building Automation Contractor. Label to read "No Cooling when Partition is Open to Gym".
- 3.2.12. Limits and Safeties
- 3.2.12.1. The maximum outdoor air damper position is limited based on the outdoor air temperature to prevent excessively low supply air temperature during startup. At -20 °C outdoor air temperature, and below, the maximum outdoor air damper position will be 0 % open and at 10 °C outdoor air temperature the maximum outdoor air damper position will be 100 %.
- 3.2.12.2. The mixed air temperature sensor acts as a low limit to ensure temperature does not fall below setpoint (typically 11 °C). In applications where the mixed air sensor is located after the DX cooling coil, the setpoint is reduced (to typically 5 °C) when DX cooling is enabled.
- 3.2.12.3. The supply air temperature sensor acts as a high limit for each stage of heating (for stage 1: disable above 60 °C , and enable below 50 °C, for stage 2: disable above 55 °C and enable below 45 °C) and a low limit for each stage of cooling (for stage 1: disable DX1 below 5 °C and enable DX1 above 10 °C, for stage 2: below 8 °C disable DX2 and above 13 °C enable DX2).
- 3.2.12.4. The supply air temperature sensor acts as a software freezestat (trigger above 1 °C and restore above 5 °C) after 1 minute delay, auto reset after 5 minute delay).
- 3.2.12.5. The supply fan has a delay-off time of 90 seconds.
- 3.2.12.6. The DX cooling has a minimum-off time of 5 minutes.
- 3.2.12.7. DX cooling is disabled when the outdoor air temperature is below global DX disable setpoint (typically 2 °C below Cooling Enable setpoint) or when fan is off.
- 3.2.12.8. Gas heating is disabled when the outdoor air temperature is above the global heating disable setpoint (typically 2 °C above Heating Enable setpoint) or when the fan is off.
- 3.2.12.9. Stage 1 gas heating (where applicable for units with multiple stages of heating) has a minimum run time of 3 minutes.
- 3.2.12.10. Minimum outdoor air is provided when enabled by the global minimum outdoor air time schedule. The minimum outdoor air is adjustable from the graphic and is typically a default of 10 % open outdoor damper position.
- 3.2.12.11. The return air carbon dioxide sensor acts as a high limit to increase the amount of minimum outdoor air from 0 % to 40 % as the reading increases from 1000 ppm to 1200 ppm.
- 3.2.12.12. Cooling cannot turn on until heating has been off for a minimum of 5 minutes.
- 3.2.12.13. During Occupied Mode, and the outdoor air is above -1 °C, heating stage 2 (where applicable) has a delay-on time of 15 minutes, except when the outdoor air temperature is below -3 °C with a +2 °C deadband.
- 3.2.12.14. The default room temperature setpoint is increased by 2 °C when mechanical cooling is enabled (providing heating is disabled). The standard mechanical cooling setpoint will be limited to a minimum of 23.5 °C.
- 3.2.12.15. When the ventilation lockout switch (usually located at the custodial office) is engaged, the outdoor air dampers close, free cooling is disabled, and the system switches to standby mode of operation.
- 3.2.12.16. Minimum outdoor air is set to zero when the global ventilation schedule is off (standby occupancy).
- 3.2.12.17. Discretionary Fire Alarm Shutdown Mode to be enabled on the fire alarm status.
- 3.2.13. Alarms:
An alarm will be generated upon the following conditions:
- 3.2.13.1. Fan status does not match the start/stop signal.

- 3.2.13.2. Mixed air temperature too high alarm, (triggered above 50 °C and restored below 48 °C) or too low alarm (triggered below 5 °C and restored above 7 °C). Low mixed air temperature alarm set to lower thresholds when Mixed Air Temperature sensor is installed after the DX/cooling coil.
- 3.2.13.3. Supply air temperature too high alarm (triggered above 65 °C and restored below 63 °C) or too low alarm (triggered below 5 °C and restored above 7 °C).
- 3.2.13.4. Space temperature too high alarm (triggered above 42 °C and restored below 40 °C) for non-cooling systems, (triggered above 38 °C and restored above 36 °C) for cooling systems.
- 3.2.13.5. Space temperature too low alarm (triggered above 14 °C and restored above 16°C).
- 3.2.13.6. Weekly fan runtime limit exceeded.
- 3.2.13.7. Return air CO₂ too high alarm (triggered above 1700 ppm and restored below 1650 ppm) or too low alarm (triggered below 250 and restored above 300 ppm) with a 15 minute delay.
- 3.2.13.8. Software freezestat tripped.

3.3. Gym HV Rooftop Sequence of Operations: (with Heating and Ventilating Only)

- 3.3.1. Discretionary Fire Alarm Shutdown Mode:
The supply fan is off, the return fan is off (where applicable) and power exhaust fan is off (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position, heating is disabled. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal HV unit functions are auto restored on relay signal from the fire alarm panel reset.
- 3.3.2. Software Freezestat Shutdown Mode:
The duct/unit mounted supply air temperature sensor acts as a software freezestat (triggered below 1°C after 3 minutes, restored above 5°C after 3 minutes, and auto reset after 5 minute delay).
- 3.3.3. Unoccupied Mode:
Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday.
The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes.
The system will cycle between Idle State, Heating State Pushbutton Override States to meet the demands from each state and return to the Idle State when the demands are satisfied.
- 3.3.3.1. (Idle State)
The supply fan is off, the return fan is off (where applicable), the power exhaust fan is off (where applicable), Global Ventilation Schedule is disabled, the outdoor air mixing dampers are in the 0 % outdoor air position, the heating is disabled.
- 3.3.3.2. (Heating State)
System cycles on a call for unoccupied heating. A full call for (all stages or full heat modulation where applicable) heating until setpoint is reached.
Heating temperature nominally 16.0 °C space temperature setpoint with an increased space temperature setpoint to 17.0 °C at -10.0 °C OAT or lower and 18.0 °C at -20.0 °C OAT or lower (each adjustable)
Free Cooling: Disabled
Global Ventilation Schedule: Disabled
- 3.3.3.3. (Push Button Override State)
If the override pushbutton is pressed, at any gym sensor, the associated system will switch to the Occupied Mode for 2 hours (adjustable). With outdoor air ventilation enabled.
- 3.3.4. Morning Warmup Mode:
An optimized start, based on the time of day schedule, outdoor air temperature and the indoor zone temperature is provided for heating.
The global Global Ventilation Schedule is disabled. The supply fan is on, the return fan is on (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position and heating is enabled at full capacity.
The optimized start program is to begin up to 105 minutes (adjustable) before the occupancy schedule to allow for morning warm up to bring the lowest space temperature up to occupancy setpoint.
- 3.3.5. Occupied Mode:
Time of day schedule, which starts the unit along with an Optimum Start program usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule, Standby Occupancy Mode or Unoccupied Mode.
Global Ventilation Schedule is enabled.
HV unit fan status confirmed by current sensing device(s) or VFD feedback.
Fan operation: The supply fan and return fan (where applicable) run continuously.
Room heating temperature nominal: 21.5 °C +/- 1.0 °C (adjustable, 2.0 °C for gyms)

For modulating burners, (where applicable) 0 % signal (0 Volts) heating discharge temperature setpoint is at minimum discharge temperature (typically set on the HV unit to 17 °C). A 100 % signal (10 Volts) heating discharge temperature setpoint is at maximum discharge temperature setpoint (typically set on the HV unit to 35 °C).
Room Free Cooling Enabled temperature nominal 22.0 °C +/-1.0 °C (adjustable, 2.0 °C for gyms)

3.3.6. Standby Occupancy Mode:

Time of day schedule starts the unit(s) usually between 4:00 p.m. and 11:00 p.m. Monday to Friday. Minimum Outdoor Air is set to zero when the Global Ventilation Schedule is off. Supply fan and return fan (where applicable) runs only on a call from heating. Ventilation normally set to zero (with a future provision to adjust).
Room heating temperature nominal: 21.5 °C +/- 1.0°C (adjustable, 2.0 °C for gyms)
Room Free Cooling: Disabled
Global Ventilation Schedule: Disabled

3.3.7. Ventilation Lockout (Sequence):

When the ventilation lockout switch, usually located in the Custodial Office, is engaged, all outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode of operation.

3.3.8. Heating Sequence

3.3.8.1. Outdoor Air Temperature used to determine Heating Enabled Mode:

A set of thresholds that are user adjustable at a Global (board wide) or Local (site specific) level, triggers the heating enable mode based on the outdoor air temperature below the threshold. The threshold is further adjusted by a calendar schedule. Typical default values are: 16 °C from September to May and 5 °C from June to August.

3.3.8.2. Default Setpoint:

When the Heating Mode is active, the default room temperature setpoint remains unchanged.

3.3.8.3. Call for Heating:

Heating is used until the heating calls (from room controller PID or unoccupied heating thresholds) are satisfied.
For modulating burners, (where applicable) 0 % signal (0 Volts) heating discharge temperature setpoint is at minimum discharge temperature (typically set on the rooftop unit to 17 °C). A 100 % signal (10 Volts) heating discharge temperature setpoint is at maximum discharge temperature setpoint (typically set on the rooftop unit to 35 °C).
The room temperature sensor regulates heating output to maintain the occupied heating setpoint. Local setpoint adjustment is provided. The power exhaust fan or relief fan (if applicable) cycles based on the rooftop economizer position..

3.3.9. Economizer Operation (and CO₂ Demand Control Ventilation):

3.3.9.1. During Occupied Mode, economizer operation will be substituted for mechanical cooling when the outdoor air temperature and relative humidity are below the Free Cooling Setpoint Sequence of Operation. If the outdoor air temperature is below this free cooling setpoint the mixing dampers will be modulated open on a call for cooling to provide 'free' cooling.

3.3.9.2. Minimum outdoor air damper position signal may exceed the economizer signal. A typical value for minimum outdoor air damper position is 5 % outdoor air, which can vary based on use case of the occupied space based on ASHRAE 62.1 net occupiable floor area outdoor air rate.

3.3.9.3. For HV units with power exhaust, the exhaust fan runs when the outdoor air damper is more than 50 % open.

3.3.9.4. During morning warm-up, the outdoor air minimum position is set to zero.

3.3.9.5. During Unoccupied Mode and Standby Occupancy Mode, free cooling is unavailable.

3.3.9.6. During Occupied Mode, If the outdoor air temperature and relative humidity are above the Free Cooling Setpoint Sequence of Operation, the mixing dampers will be set to the minimum outdoor air threshold unless otherwise required under ASHRAE 62.1 Ventilation Rate Procedure - net occupiable floor area outdoor air rate (w/ CO₂ demand controlled ventilation reset).

3.3.9.7. Each return air duct-mounted or space mounted CO₂ sensor acts as a high limit and will increase the amount of minimum outdoor air, to a maximum of 40 % outdoor air as the CO₂ level increases from 1100 ppm (1000 ppm to 1200 ppm over a ramped 15 minute period).

3.3.10. Gym Partition Switch

The gym partition position switch (where applicable for multiple gyms) indicates whether the dividing wall is open or closed. If the wall is open, the two rooftop units (where applicable) control to an average room temperature setpoint. If the wall is closed, the two rooftop units (where applicable) operate autonomously. Gym partition switch to be provided by the Building Automation Contractor.

3.3.11. Additional Rooms Partition Switch

Any additional room(s) (ie. Music Rooms) that are separated by a partition wall, will disable mechanical cooling (where applicable) for the associated units that serve the additional room(s). If the Music Room wall is open to the Gym, mechanical cooling serving the Music Room is disabled. Partition switch and lamacoid label to be provided above Music Room Sensor by the Building Automation Contractor. Label to read "No Cooling when Partition is Open to Gym".

- 3.3.12. Limits and Safeties
- 3.3.12.1. The maximum outdoor air damper position is limited based on the outdoor air temperature to prevent excessively low supply air temperature during startup. At -20 °C outdoor air temperature, and below, the maximum outdoor air damper position will be 0 % open and at 10 °C outdoor air temperature the maximum outdoor air damper position will be 100 %.
- 3.3.12.2. The mixed air temperature sensor acts as a low limit to ensure temperature does not fall below setpoint (typically 11°C).
- 3.3.12.3. The supply air temperature sensor acts as a high limit for each stage of heating (for stage 1: disable above 60 °C , and enable below 50 °C, for stage 2: disable above 55 °C and enable below 45 °C) and a low limit for each stage of cooling (for stage 1: disable DX1 below 5 °C and enable DX1 above 10 °C, for stage 2: below 8 °C disable DX2 and above 13 °C enable DX2).
- 3.3.12.4. The duct mounted supply air temperature sensor acts as a software freezestat (triggered below 1 °C, restored above 5 °C), 1 minute delay, auto reset after 5 minute delay).
- 3.3.12.5. The supply fan has a delay-off time of 90 seconds.
- 3.3.12.6. Gas heating is disabled when the outdoor air temperature is above the global heating disable setpoint (typically 18 °C) or when the fan is off.
- 3.3.12.7. Stage 1 gas heating (where applicable for staged heating) has a minimum run time of 3 minutes.
- 3.3.12.8. Minimum outdoor air is provided when enabled by the global minimum outdoor air time schedule. The minimum outdoor air is adjustable from the graphic and is typically a default of 10 % open outdoor damper position.
- 3.3.12.9. The return air carbon dioxide sensor acts as a high limit to increase the amount of minimum outdoor air damper position from 0 % to 40 % as the return air carbon dioxide reading increases from 1000 ppm to 1200 ppm.
- 3.3.12.10. During Occupied Mode, and the outdoor air is above -1 °C, heating stage 2 (where applicable) has a delay-on time of 15 minutes, except when the outdoor air temperature is below -3 °C with a +2 °C deadband.
- 3.3.12.11. The default space setpoint is increased by 2 °C when free cooling is enabled (providing heating is disabled). The standard cooling setpoint will be limited to a minimum of 23.5°C.
- 3.3.12.12. When the ventilation lockout switch (usually located at the custodial office) is engaged, the outdoor air dampers close, free cooling is disabled, and the system switches to standby mode of operation.
- 3.3.12.13. Minimum outdoor air is set to zero when the global ventilation schedule is off (standby occupancy).
- 3.3.12.14. Discretionary Fire Alarm Shutdown Mode to be enabled on the fire alarm status.

- 3.3.13. Alarms:
- An alarm will be generated upon any of the following conditions:
- 3.3.13.1. Fan status does not match the start/stop signal.
- 3.3.13.2. Mixed air temperature too high alarm (triggered above 50 °C restored below 48 °C) or too low alarm (triggered below 5 °C and restored above 7 °C). Supply air temperature too high alarm (triggered above 65 °C and restored below 63 °C) or too low alarm (triggered below 5 °C and restored above 7 °C)
- 3.3.13.3. Space temperature too high alarm (triggered above 42 °C and restored below 40 °C) for non-cooling systems, (triggered above 38 °C and restored below 36 °C) for cooling systems.
- 3.3.13.4. Space temperature too low alarm (triggered below 14 °C and restored above 16 °C).
- 3.3.13.5. Weekly fan runtime limit exceeded.
- 3.3.13.6. Return air CO₂ too high alarm (triggered above 1700 ppm and restored below 1650 ppm) or too low alarm (triggered below 250 ppm and restored above 300 ppm).
- 3.3.13.7. Software freezestat tripped

3.4. HRV and ERV Unit Sequence of Operations:

3.4.1. Discretionary Fire Alarm Shutdown Mode:

The supply fan is off, the exhaust fan is off, all the outside air dampers spring closed to the 0 % outdoor air position. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal HRV / ERV unit functions are auto restored on the relay signal from the fire alarm panel reset.

3.4.2. Software Freezestat Shutdown Mode:

The duct/unit mounted supply air temperature sensor downstream of the wheel/core acts as a software freezestat (triggered below 1 °C for 3 minutes, restored above 5 °C for 3 minutes, and auto reset after 5 minute delay).

3.4.3. Unoccupied Mode:

The exhaust fan is off, the supply fan is off, and the intake and exhaust dampers are spring return.

3.4.4. Morning Warmup Mode:

Not applicable. Same as Unoccupied mode.

3.4.5. Occupied Mode:

The supply and exhaust fans run continuously when any associated rooftop unit is operating in Occupied Mode, the economizers are less than 30 % outside air dampers position and the Global Ventilation Schedule is on. Fan status indication is from the current sensing device(s). Fan operation: The supply fan (except for freeze protection) and exhaust fan run continuously.

3.4.6. Econo Mode:

3.4.7. The Econo Mode will be enabled when the outside air damper position across all associated HVAC / HV units are equal to or greater than 30 % for more than 15 minutes, indicating that the HVAC / HV units are in free cooling mode. The HRV / ERV will be disabled on a call from BAS and all associated dampers shall spring closed.

3.4.8. If any associated outside air damper position across all associated HVAC units are equal to or less than 30 % for more than 15 minutes the Econo Mode will be disabled and HRV / ERV unit operation will resume.

3.4.9. The Econo Mode will not be applicable to HRV / ERV units serving washrooms.

3.4.10. Standby Occupancy Mode:

Not applicable. Same as Unoccupied Mode.

3.4.11. Ventilation Lockout (Sequence):

When the ventilation lockout switch, usually located in the Custodial Office, is engaged, supply and exhaust fans stop, all dampers spring close, and the system switches to Unoccupied Mode of operation.

3.4.12. Limits and Safeties

3.4.12.1. Defrost control provided by the ERV/HRV manufacturer. The internal frost controls (supply fan stops, exhaust fan defrosts the core).

3.4.12.2. Systems that have electric or hydronic reheat are to be avoided.

3.4.12.3. The supply air sensor acts as a software freezestat (triggered below 1 °C for 3 minutes, restored above 5 °C for 3 minutes, and auto reset after 5 minute delay).

3.4.12.4. The supply and exhaust fans stop on a fire alarm condition.

3.4.12.5. If the mixed air damper position exceeds 30 % outdoor air on all associated HVAC units, the HRV/ERV supply and exhaust fans stop. Not applicable to units that serve washrooms.

3.4.12.6. If deemed required, ERV/HRV's exhaust fans may need to continue to run for systems serving washroom exhausts when the system is not in occupied mode. (Revisit issue with consultants)

3.4.13. Alarms:

An alarm will be generated upon the following conditions:

3.4.13.1. After 15 minute delay (adjustable), supply fan status does not match the start/stop signal.

3.4.13.2. After 15 minute delay (adjustable), exhaust fan status does not match the start/stop signal.

3.4.13.3. Supply air temperature too high alarm (triggered above 35 °C and restored below 33 °C) or too low alarm (triggered 1 °C and restored below 3 °C)

3.4.13.4. Return air temperature too high alarm (triggered above 40 °C and restored below 38 °C) or too low alarm (triggered above 14 °C and restored below 15 °C)

3.4.13.5. Exhaust air temperature too high alarm (triggered above 40 °C and restored below 38 °C) or too low alarm (triggered below -1 °C and restored above 1 °C).

3.4.13.6. Weekly fan runtime limit exceeded.

3.5. Unit Ventilators Sequence of Operations:

3.5.1. Discretionary Fire Alarm Shutdown Mode:

The supply fan is off, and associated exhaust fan is off (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position, the hydronic heating remains in its current state and the cooling is off (where applicable).

The face and bypass damper are open to the face of the coil(s).

The associated relief dampers (where applicable) are in the closed position.

This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal UV unit functions are auto restored on relay signal from the fire alarm panel reset.

3.5.2. Software Freezestat Shutdown Mode:

The duct/unit mounted supply air temperature sensor acts as a software freezestat (triggered below 1 °C after 3 minutes, restored above 5 °C after 3 minutes, and auto reset after 5 minute delay).

3.5.3. Unoccupied Mode

The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes. The system will cycle between Idle State, Heating State and Pushbutton Override States to meet the demands from each state and return to the Idle State when the demands are satisfied.

3.5.3.1. (Idle State)

Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday. The supply fan is off, associated exhaust fan is off (where applicable), the Global Ventilation Mode is off, the outdoor air mixing dampers are in the 0% outdoor air position, the heating is off and the cooling is off (where applicable). The face and damper is in the face position. The associated relief dampers (where applicable) are closed.

3.5.3.2. (Heating State)

System cycles on a call for unoccupied heating. The face and bypass dampers go to face position to obtain room temperature setpoint.

Heating temperature nominally 16.0 °C space temperature setpoint with an increased space temperature setpoint to 17.0 °C at -10.0 °C Outdoor Air Temperature or lower and 18.0 °C at -20.0 °C Outdoor Air Temperature or lower (each adjustable).

Mechanical Cooling: Disabled (where applicable)

Free Cooling: Disabled

Global Ventilation Schedule: Disabled

3.5.3.3. (Push Button Override State)

If the override pushbutton is pressed, at any room sensor, the associated system will switch to the Occupied Mode for 2 hours (adjustable). With outdoor air ventilation and cooling enabled.

3.5.4. Morning Warmup Mode:

An optimized start routine for heating advances the system start time when morning warm-up is required. An optimized start, based on the time of day schedule, outdoor air temperature and the room temperature is provided for heating. The global ventilation schedule is off.

The supply fan is on, the associated exhaust fan is off (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position, the heating at full capacity is on and the cooling is off (where applicable).

The heat pump (where applicable) is the first stage of heat but when it is in defrost mode or when the outdoor air is too cold, then hydronic heat is used to provide heat.

The face and bypass damper(s) start in the face position. The associated exhaust dampers (where applicable) start in the closed position.

The optimized start program is to begin up to 105 minutes before the occupancy schedule to allow for morning warm up to bring the lowest zone temperature up to occupancy setpoint.

3.5.5. Occupied Mode

Time of day schedule, which starts the unit along with an Optimum Start program usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule, Standby Occupancy Mode or Unoccupied Mode.

The Global Ventilation Schedule is on.

Fan status indication is from the current sensing device(s).

Fan operation: The supply fan and return fan (where applicable) run continuously.

Heating temperature nominal: 21.5 °C +/- 1.0 °C (adjustable)

Mechanical cooling temperature nominal 24.5 °C +/- 1.0 °C (adjustable)

Free cooling enabled temperature nominal 22.5 °C +/-1.0 °C

Global Ventilation Schedule: Enabled

3.5.6. Standby Occupancy Mode:

Time of day schedule starts the unit(s) usually between 4:00 p.m. and 11:00 p.m. Monday to Friday.

Minimum Outdoor Air is set to zero when the Global Ventilation Schedule is off.

Fan operation: Supply fan and associated exhaust fan (where applicable) runs only on a call from heating or cooling only.

Ventilation normally set to zero (with a future provision to adjust).

Heating temperature setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)

Mechanical Cooling temperature setpoint nominal 24.5 °C +/- 1.0 °C (adjustable) (where applicable)

Free Cooling: Disabled

Global Ventilation Schedule: Disabled

3.5.7. Ventilation Lockout (Sequence):

When the ventilation lockout switch, usually located in the Custodial Office, is engaged, all outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode of operation.

3.5.8. Heating:

3.5.8.1. Outdoor Air Temperature used to determine Heating Enable Mode:

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the heating enable mode based on the outdoor air temperature below the threshold. The threshold is further adjusted by a calendar schedule.

Typical default values are: 16 °C from September to May and 5 °C from June to August.

3.5.8.2. Default Setpoint:

When the Heating Mode is active, the default room temperature setpoint remains unchanged.

3.5.8.3. Call for Heating:

The room temperature sensor modulates the face & bypass damper with heat pump or hydronic heating to maintain the temperature setpoint.

The heat pump is the first stage of heat (nominally to 5 °C outdoor air temperature) but when it is in defrost mode or when the outdoor air is too cold, then hydronic heat is used to provide heat.

When in heating mode, the mixing dampers are in minimum position and cooling is off.

Mechanical heating is used until the heating calls (from room controller PID or Unoccupied Heating thresholds) are satisfied.

The room temperature sensor regulates heating output to maintain the occupied heating setpoint. Local setpoint adjustment is provided.

Where there is a zone served by radiation, the radiation valve opens (where applicable) as the first stage of heating.

Hydronic

For Heating Valve, (where applicable) 0 % signal (10 Volts) closes the heating valve. A 100% signal (below 2 Volts) opens the heating valve.

Supplemental Electric Space Heating

Where there is a zone supplemented by electric space heating, the electric heater starts (where applicable) and is to be utilized as the second stage of heating.

3.5.9. Cooling Sequence:

3.5.9.1. Outdoor Air Temperature used to determine cooling enable mode:

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the cooling enable mode based on the Outdoor Air Temperature exceeding the threshold. The threshold is further adjusted by a calendar schedule. Typical default values are: 18 °C from September to May and 21 °C from June to August.

3.5.9.2. Default Setpoint:

When the cooling enable mode is active, the default room temperature setpoint is raised by 2 °C.

3.5.9.3. Call for Cooling:

When free cooling is available, and a demand for cooling is in place, free cooling will be used first, and if the demand for cooling is still in place, mechanical cooling will be used until the cooling calls (from room controller PID) are satisfied.

The room temperature sensor also modulates the mixing dampers (for free cooling) to maintain the occupied free cooling setpoint

Heating temperature setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)

The heat pump is the first stage of heat but when it is in defrost mode or when the outdoor air is too cold, then hydronic heat is used to provide heat.

Cooling setpoint is maintained at 3 °C higher than the default room setpoint and will not go below 23.5 °C.

Mechanical Cooling temperature setpoint nominal 24.5 °C +/- 1.0 °C (adjustable)

The room temperature sensor modulates the mixing dampers in sequence with DX cooling (where applicable) and face and bypass dampers in face position, to maintain the cooling temperature setpoint.

When mechanical cooling is on, heating is off.

3.5.10. Economizer Operation (and CO2 Demand Control Ventilation):

3.5.10.1. During Occupied Mode, economizer operation will be substituted for first stage mechanical cooling when the outdoor air temperature and relative humidity are below the Free Cooling Setpoint Sequence of Operation. If the outdoor air temperature is below this Free Cooling Setpoint the mixing dampers will be modulated open on a call for cooling to provide 'free' cooling.

3.5.10.2. Minimum outdoor air damper position signal may exceed the economizer signal. A typical value for minimum outdoor air damper position is 5 % outdoor air, (0 % when an associated stand alone ERV is present) which can vary based on use case of the occupied space based on ASHRAE 62.1 net occupiable floor area outdoor air rate.

3.5.10.3. For units with an associated exhaust, the exhaust fan runs when the outdoor air damper is more than 50 % open.

3.5.10.4. During morning warm-up, the outdoor air minimum position is set to zero.

3.5.10.5. During Unoccupied Mode and Standby Occupancy Mode, free cooling is unavailable.

3.5.10.6. During Unoccupied Mode, If the outdoor air temperature and relative humidity are above the Free Cooling Setpoint Sequence of Operation, the mixing dampers will be set to the minimum outdoor air threshold unless otherwise required under ASHRAE 62.1 Ventilation Rate Procedure - net occupiable floor area outdoor air rate (w/ CO₂ demand controlled ventilation reset).

3.5.10.7. Each return air duct-mounted or space mounted CO₂ sensor acts as a high limit and will increase the amount of minimum outdoor air, to a maximum of 40 % outdoor air as the CO₂ level increases from 1100 ppm (1000 ppm to 1200 ppm over a ramped 15 minute period).

3.5.11. Limits and Safeties

3.5.11.1. If the outside air temperature exceeds the Global Free Cooling Setpoint, the mixing dampers return to the minimum position.

3.5.11.2. Mixed air damper minimum position control is provided when the Global Ventilation Schedule is on (initially 10 %OA).

3.5.11.3. The exhaust air damper (if applicable) opens from 0 to 100 % as the outdoor air damper opens from minimum position to maximum position.

- 3.5.11.4. The minimum outdoor damper position is ramped from minimum to 40 % as the room sensor CO₂ increased from 1000 ppm to 1200 ppm over a 15 minute period.
- 3.5.11.5. The fan must be running before the mixing dampers, face and bypass dampers, heat pump (if applicable) and DX cooling will operate.
- 3.5.11.6. The economizer is limited to 60 % because of the intake louver dimensions. (if applicable)
- 3.5.11.7. The supply air sensor acts as a low limit to ensure temperature does not fall below setpoint (initially 16 °C, reset to 13 °C on a call for free cooling).
- 3.5.11.8. A software freezestat on the supply air temperature shuts the fan down and closes the outdoor air damper when the supply air temperature is below 3 °C for 30 seconds (resets above 6 °C with 5 minute delay before restart).
- 3.5.11.9. If the hard-wired freezestat trips, the fan shuts down, the heat pump shuts down (if applicable), the outside air damper closes, the heating valve opens and an alarm is generated at the BAS.
- 3.5.11.10. DX cooling is disabled when the outside air temperature falls below the global mechanical cooling disable setpoint (initially 14 °C).(where applicable)
- 3.5.11.11. DX cooling has a minimum off time of 5 minutes.(where applicable)
- 3.5.11.12. DX cooling has a supply air temperature low limit (disabled below 6 °C and enabled above 12 °C). (where applicable)
- 3.5.11.13. The face & bypass damper is in the face position and the heating valve is closed when DX cooling is operating, (where applicable)
- 3.5.11.14. The heat pump is disabled when the outdoor air temperature is below 5 °C and hydronic heat is used (where applicable)
- 3.5.11.15. Defrost mode is determined by a sudden drop in supply air temperature while the heat pump is heating.
- 3.5.11.16. 16) Heating is disabled when the outside air temperature is above the global heating disable setpoint (typically 16 °C).
- 3.5.11.17. 17) The heating valve min. position increases from 0 to 60% as the outside air temperature falls from 3 °C to -3 °C to reduce the likelihood of coil freeze.

3.5.12. Alarms

An alarm will be generated upon any of the following conditions:

- 3.5.12.1. Fan status does not match the fan start/stop signal.
- 3.5.12.2. Room temperature is too high (triggered above 36 °C and restored below 34 °C) or too low (triggered below 14 °C and restored above 15 °C).
- 3.5.12.3. Supply air temperature too high (triggered above 65 °C and restored below 60 °C) or too low (triggered below 8 °C and restored above 10 °C).
- 3.5.12.4. Software or hard-wired freezestat tripped.
- 3.5.12.5. Fan runtime exceeded weekly runtime setpoint.
- 3.5.12.6. CO₂ level too high (triggered above 1700 ppm and restored below 1650 ppm) or too low (triggered below 250 ppm and restored above 300 ppm).
- 3.5.12.7. Heat pump defrost mode is on more than 40 % of the time.

3.6. Air Handlers Sequence of Operations:

3.6.1. Discretionary Fire Alarm Shutdown Mode:

The supply fan is off, the return fan is off (where applicable) and power exhaust fan is off (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position, heating is disabled and cooling is disabled. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal AHU functions are auto restored on relay signal from the fire alarm panel reset.

3.6.2. Freeze-stat Shutdown Mode(s):

3.6.2.1. Software

The duct/unit mounted supply air temperature sensor acts as a software freeze-stat (triggered below 1 °C after 3 minutes, restored above 5 °C after 3 minutes, and auto reset after 5 minute delay).

3.6.2.2. Hard-Wired

BAS monitors the status of the duct mounted hard wired freeze-stat (provided by others, where applicable) that shuts down the AHU fan(s) and spring closes the outside air damper(s) if the air temperature leaving the heating coil falls below the freeze-stat setpoint.

3.6.3. Unoccupied Mode:

Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday.

The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes.

The system will cycle between Idle State, Heating State or Pushbutton Override States to meet the demands from each state and return to the Idle State when the demands from each state are satisfied.

3.6.3.1. (Idle State)

The supply fan is off, associated return fan is off (where applicable), the Global Ventilation Mode is disabled, the outdoor air mixing dampers are in the 0 % outdoor air position, the gas heating is disabled (where applicable) and the cooling is disabled (where applicable).

For hydronic heated AHU, when outdoor air temperature is below 3 °C, the heating valve (where applicable) modulates to maintain a supply air plenum temperature of 15 °C. When outdoor air temperature is 3 °C or above, the heating valve (where applicable) is closed to the coil. The heating coil circulating pump (where applicable) runs continuously in Winter Mode.

3.6.3.2. (Heating State)

System cycles on a call for unoccupied heating. A full call for (all stages or full heat modulation where applicable) heating until setpoint is reached.

Heating temperature nominally 16.0 °C space temperature setpoint with an increased space temperature setpoint to 17.0 °C at -10.0 °C OAT or lower and 18.0 °C at -20.0 °C OAT or lower (each adjustable)

Free Cooling: Disabled

Global Ventilation Schedule: Disabled

3.6.3.3. Push Button Override State)

If the override pushbutton is pressed, at any associated room sensor, the associated system will switch to the Occupied Mode for 2 hours (adjustable). With outdoor air ventilation enabled.

3.6.4. Morning Warmup Mode:

An optimized start, based on the time of day schedule, outdoor air temperature and the indoor zone temperature is provided for heating.

The global Global Ventilation Schedule is disabled. The supply fan is on, the return fan is on (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position and heating is enabled at full capacity.

The optimized start program is to begin up to 105 minutes (adjustable) before the occupancy schedule to allow for morning warm up to bring the lowest space temperature up to occupancy setpoint.

3.6.5. Occupied Mode:

Time of day schedule, which starts the unit along with an Optimum Start program usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule, Standby Occupancy Mode or Unoccupied Mode.

Global Ventilation Schedule is enabled.

Air handler fan status confirmed by current sensing device(s) or VFD feedback.

Fan operation: The supply fan and return fan (where applicable) run continuously.

Room heating temperature nominal: 21.5 °C +/- 1.0 °C (adjustable)

For modulating burners, (where applicable) 0 % signal (0 Volts) heating discharge temperature setpoint is at minimum discharge temperature (typically set on the HV unit to 17 °C). A 100 % signal (10 Volts) heating discharge temperature setpoint is at maximum discharge temperature setpoint (typically set on the HV unit to 35 °C).

Room Free Cooling Enabled temperature setpoint nominal 22.5 °C +/-1.0 °C

Room Mechanical Cooling temperature setpoint nominal 24.5 °C +/- 1.0 °C (adjustable)

3.6.6. Standby Occupancy Mode:

Time of day schedule starts the unit(s) usually between 4:00 p.m. and 11:00 p.m. Monday to Friday. Minimum Outdoor Air is set to zero when the Global Ventilation Schedule is off. Supply fan and return fan (where applicable) runs only on a call from heating.

Ventilation normally set to zero (with a future provision to adjust).

Room heating temperature nominal: 21.5 °C +/- 1.0°C

Room Free Cooling: Disabled

Mechanical Cooling: Enabled

Global Ventilation Schedule: Disabled

3.6.7. Ventilation Lockout (Sequence):

When the ventilation lockout switch, usually located in the Custodial Office, is engaged, all outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode of operation.

3.6.8. Heating Sequence:

3.6.8.1. Outdoor Air Temperature used to determine Heating Enabled Mode:

A set of thresholds that are user adjustable at a Global (board wide) or Local (site specific) level, triggers the heating enable mode based on the outdoor air temperature below the threshold. The threshold is further adjusted by a calendar schedule.

Typical default values are: 16 °C from September to May and 5 °C from June to August.

3.6.8.2. Default Setpoint:

When the Heating Mode is active, the default room temperature setpoint remains unchanged.

3.6.8.3. Call for Heating:

Heating is used until the heating calls (from room controller PID or unoccupied heating thresholds) are satisfied.

For modulating burners, (where applicable) 0 % signal (0 Volts) heating discharge temperature setpoint is at minimum discharge temperature (typically set on the unit to 17 °C). A 100 % signal (10 Volts) heating discharge temperature setpoint is at maximum discharge temperature setpoint (typically set on the unit to 35 °C).

For hydronic heated AHUs, (where applicable) 0 % signal (10 Volts) closes the heating valve. A 100% signal (2 Volts) opens the heating valve. (Note: The heating valve is reverse acting to the controller output signal and is to fail safe open)

The heating coil circulating pump (where applicable) runs continuously in Winter Mode.

The room temperature sensor with the lowest temperature regulates heating output to maintain the occupied heating setpoint.

Local setpoint adjustment is provided. The power exhaust fan or relief fan (if applicable) cycles based on the rooftop economizer position.

Where there is a zone served by radiation, the radiation valve opens (where applicable) as the first stage of heating.

3.6.9. Mechanical Cooling Sequence:

3.6.9.1. Default Setpoint:

When the Mechanical Cooling Mode is active, the default room temperature cooling setpoint is 24.5 °C +/- 1°C and will not go below 23.5 °C.

3.6.9.2. Call for Cooling:

Mechanical cooling will be used until the cooling calls (from room controller PID) are satisfied.

3.6.9.3. Chilled Water Cooling Sequence:

3.6.9.4. Unoccupied Mode

The cooling coil valve is closed. There can be no unoccupied cooling.

3.7. Occupied Mode

The cooling coil valve modulates open when there is chilled water in the CW Mains.

3.7.1. Free Cooling Sequence:

3.7.1.1. Outdoor Air Temperature used to determine cooling enable mode:

(Free cooling enabled) A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the cooling enable mode based on the outdoor air temperature exceeding the threshold. The threshold is further adjusted by a calendar schedule.

Typical default values are: 18 °C from September to May and 21 °C from June to August.

3.7.1.2. Default Setpoint:

When the cooling enable mode is active, the default room temperature setpoint is raised by 2 °C higher than the heating setpoint and will not go below 23.5 °C

3.7.1.3. Call for Cooling:

When free cooling is available, and a demand for cooling is in place, free cooling will be used, until the cooling calls (from room controller PID) are satisfied.

The room temperature sensor also modulates the mixing dampers (for free cooling) to maintain the occupied free cooling setpoint.

3.7.2. Economizer Operation (and CO₂ Demand Control Ventilation):

During Occupied Mode, economizer operation will be substituted for first stage mechanical cooling when the outdoor air temperature and relative humidity are below the Free Cooling Setpoint Sequence of Operation. If the outdoor air temperature is below this free cooling setpoint the mixing dampers will be modulated open on a call for cooling to provide 'free' cooling.

3.7.2.1. Minimum Outdoor Air Damper Position

A typical value for minimum outdoor air damper position is 5 % outdoor air, (0 % when an associated stand alone ERV is present) which can vary based on use case of the occupied space based on ASHRAE 62.1 net occupiable floor area outdoor air rate.

Minimum outdoor air damper position signal may exceed the economizer signal.

3.7.2.2. Economizer Operation

The outdoor air mixing dampers will be set to the minimum outdoor air position unless otherwise required under ASHRAE 62.1 Ventilation Rate Procedure - net occupiable floor area outdoor air rate (w/ CO₂ demand controlled ventilation reset).

If Free Cooling is enabled during Occupied Mode, economizer operation will be substituted for first stage mechanical cooling, the mixing dampers will be modulated open on a call for cooling to provide 'free' cooling.

For air handling units with power exhaust (where applicable), the exhaust fan runs when the outdoor air damper is more than 50 % open

During morning warm-up, the outdoor air minimum position is set to zero.

During Unoccupied Mode and Standby Occupancy Mode, free cooling is unavailable.

Each return air duct-mounted or space mounted CO₂ sensor acts as a high limit and will increase the amount of minimum outdoor air, to a maximum of 40 % outdoor air as the CO₂ level increases from 1000 ppm to 1200 ppm over a ramped 15 minute period).

CO₂ levels are automatically logged at 10 minute intervals

Each return air duct-mounted or space mounted CO₂ sensor acts as a high limit and will increase the amount of minimum outdoor air, to a maximum of 40 % outdoor air as the CO₂ level increases from 1000 ppm to 1200 ppm over a ramped 15 minute period).

CO₂ levels are automatically logged at 10 minute intervals

3.7.3. Additional Rooms Partition Switch

Any additional room(s) (i.e. Music Rooms) that are separated by a partition wall from a space where cooling is not allowed, will disable mechanical cooling for the associated units that serve the additional room(s). If the Music Room wall is open to the Gym, mechanical cooling serving the Music Room is disabled. Partition switch and lamacoid label to be provided above Music Room Sensor by the Building Automation Contractor. Label to read "No Cooling when Partition is Open to Gym".

3.7.4. Limits and Safeties

- 3.7.4.1. The maximum outdoor air damper position is limited based on the outdoor air temperature to prevent excessively low supply air temperature during startup. At -20 °C outdoor air temperature, and below, the maximum outdoor air damper position will be 0 % open and at 10 °C outdoor air temperature the maximum outdoor air damper position will be 100 %.
- 3.7.4.2. The mixed air temperature sensor acts as a low limit to ensure temperature does not fall below setpoint (typically 11 °C). In applications where the mixed air sensor is located after the DX cooling coil, the setpoint is reduced (to typically 5 °C) when DX cooling is enabled.
- 3.7.4.3. The supply air temperature sensor acts as a high limit for each stage of heating (stage 1 heating disabled above 60 °C and enabled below 50 °C, stage 2 heating disabled above 55 °C and enabled below 45 °C) and a low limit for each stage of cooling (stage 1 disabled below 5 °C and enabled above 13 °C, stage 2 disabled below 8 °C and enabled above 18 °C).
- 3.7.4.4. The supply air temperature sensor acts as a software freezestat (triggered below 1 °C for 1 minute and restored above 5 °C after a 5 minute delay).
- 3.7.4.5. The supply fan has a delay-off time of 90 seconds.
- 3.7.4.6. The DX cooling has a minimum-off time of 5 minutes.
- 3.7.4.7. DX cooling is disabled when the outdoor air temperature is below global DX disable setpoint (typically 18 °C) or when fan is off.
- 3.7.4.8. Gas heating is disabled when the outdoor air temperature is above the global heating disable setpoint (typically 14 °C) or when the fan is off.
- 3.7.4.9. Stage 1 gas heating (where applicable for units with multiple stages of heating) has a minimum run time of 3 minutes.
- 3.7.4.10. Minimum outdoor air is provided when enabled by the global minimum outdoor air time schedule. The minimum outdoor air is adjustable from the graphic and is typically a default of 10 % open outdoor damper position.
- 3.7.4.11. The return air carbon dioxide sensor acts as a high limit to increase the amount of minimum outdoor air from 0 % to 40 % as the reading increases from 1000 ppm to 1200 ppm (1000 ppm to 1200 ppm over a ramped 15 minute period).
- 3.7.4.12. Cooling cannot turn on until heating has been off for a minimum of 5 minutes.
- 3.7.4.13. During Occupied Mode, and the outdoor air temperature is above -1 °C, heating stage 2 (where applicable) has a delay-on time of 15 minutes, except when the outdoor air temperature is below -3 °C with a +2 °C deadband.
- 3.7.4.14. The default room temperature cooling setpoint is 2 °C above the heating setpoint when mechanical cooling is enabled. The standard mechanical cooling room setpoint will be limited to a minimum of 23.5 °C.
- 3.7.4.15. When the ventilation lockout switch (usually located at the custodial office) is engaged, the outdoor air dampers close, free cooling is disabled, and the system switches to standby mode of operation.
- 3.7.4.16. Minimum outdoor air is set to zero when the global ventilation schedule is off.
- 3.7.4.17. Supply and Return Fan(s) disabled if the hydronic heating coil pump status is not running when required.
- 3.7.4.18. Discretionary Fire Alarm Shutdown Mode to be enabled on the fire alarm status.
- 3.7.4.19. The heating coil pump (for hydronic units where applicable) turns off when the outside air temperature exceeds the heating disable setpoint (60 second delay-off time)
- 3.7.4.20. Cooling valves are closed when the outside air temperature is below the global cooling disable setpoint or the CW mains temperature is above 20°C

3.7.5. Alarms:

An alarm will be generated upon the following conditions:

- 3.7.5.1. Supply and and or Return Fan status does not match the start/stop signal.
- 3.7.5.2. Mixed air temperature too high alarm (triggered above 50 °C and restored below 48 °C) or too low alarm (triggered below 5 °C and restored above 7 °C). Low mixed air temperature alarm set to lower thresholds when Mixed Air Temperature sensor is installed after the DX or cooling coil.
- 3.7.5.3. Supply air temperature too high alarm (triggered above 65 °C and restored below 63 °C) or too low alarm (triggered below 5 °C and restored above 7 °C)
- 3.7.5.4. Space temperature too high alarm (triggered above 42 °C and restored below 40 °C) for non-cooling systems, (triggered above 38 °C and restored below 36 °C) for cooling systems.
- 3.7.5.5. Space temperature too low alarm (triggered below 14 °C and restored above 16 °C).
- 3.7.5.6. Weekly fan runtime limit exceeded.
- 3.7.5.7. Return air carbon dioxide too high alarm (triggered above 1700 ppm and restored below 1650 ppm) or too low alarm (triggered below 250 ppm and restored above 300 ppm) with a 15 minute delay.
- 3.7.5.8. Software freezestat tripped.
- 3.7.5.9. Low mixed air temperature alarm (triggered below 5 °C and restored above 7 °C).
- 3.7.5.10. Low return air carbon dioxide alarm (triggered below 250 ppm and restored above 275 ppm) or high return air CO2 alarm (triggered above 1200 ppm and restored below 1100 ppm).

- 3.7.5.11. High supply air static pressure alarm (triggered 30 % above setpoint and restored below 10 % above setpoint) or low supply air static pressure alarm (triggered 30 % below setpoint and restored above 10% below setpoint).
- 3.7.5.12. High supply air temperature alarm (triggered above 40 °C and restored below 38°C) or low supply air temperature alarm (triggered below 8 °C and restored above 10°C).
- 3.7.5.13. Low return air temperature alarm (triggered below 14 °C and restored above 15°C) or high return air temperature alarm (triggered above 40 °C and restored below 38 °C).
- 3.7.5.14. Freezestat or differential pressure limit switch tripped.
- 3.7.5.15. Hydronic heating coil pump status in wrong mode
- 3.7.5.16. Software freezestat tripped.

3.8. VAV AHU HVAC Fan System Sequence of Operations:

3.8.1. Discretionary Fire Alarm Shutdown Mode:

The supply fan is off, the return fan is off (where applicable) and power exhaust fan is off (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position, heating is disabled and cooling is disabled. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal AHU HVAC unit functions are auto restored on relay signal from the fire alarm panel reset.

3.8.2. Freezestat Shutdown Modes:

3.8.2.1. Software

The duct/unit mounted supply air temperature sensor acts as a software freezestat (triggered below 1 °C after 30 seconds, restored above 5 °C after 5 minutes).

3.8.2.2. Hard-Wired

BAS monitors the status of the duct mounted hard wired freeze-stat (provided by others, where applicable) that shuts down the AHU fan(s) and spring closes the outside air damper(s) if the air temperature leaving the heating coil falls below the freeze-stat setpoint.

3.8.3. Unoccupied Mode:

Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday.

The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes. The system will cycle between Idle State, Heating State and Pushbutton Override State to meet the demands from each state and return to the Idle State when the demands of each state are satisfied.

3.8.3.1. (Idle State)

The supply fan is off, the return fan is off (where applicable) power exhaust fan is off (where applicable), the Global Ventilation Schedule is disabled, the outdoor air mixing dampers are in the 0% outdoor air position, and cooling is disabled. The heating valve modulates to maintain a plenum temperature of 15°C when the outside air temperature is below 1 °C and closes when outside air temperature is above 3 °C. The heating coil circulating pump (where applicable) runs continuously when Heating Mode is enabled.

3.8.3.2. (Heating State)

System cycles on a call for unoccupied heating. A full call for (all stages or full heat modulation where applicable) heating until setpoint is reached.

Heating temperature nominally 16.0 °C space temperature setpoint with an increased space temperature setpoint to 17.0 °C at -10.0 °C OAT or lower and 18.0 °C at -20.0 °C OAT or lower (each adjustable)

The VAV HVAC unit supply air static pressure setpoint is increased by 20 %. VFD(s) modulate to maintain static pressure setpoint.

Mechanical Cooling: Disabled

Free Cooling: Disabled

Global Ventilation Schedule: Disabled

3.8.3.3. (Push Button Override State)

If the override pushbutton is pressed, at any associated room sensor, the associated system will switch to the Occupied Mode for 2 hours (adjustable). With outdoor air ventilation enabled.

Mechanical Cooling: Enabled (per Cooling Enable Mode)

Free Cooling: Disabled

Global Ventilation Schedule: Enabled (only at the associated unit)

3.8.4. Morning Warmup Mode:

An optimized start, based on the time of day schedule, outdoor air temperature and the lowest indoor zone temperature is provided for heating.

The Global Ventilation Schedule is disabled.

The supply fan is on, the return fan is on (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position, heating is enabled at full capacity and cooling is disabled.

The VAV VFD drive(s) starts in the minimum position.

The VAV boxes zone dampers start in the 100 % open position.

The Optimized Start Program is to begin up to 105 minutes before the occupancy schedule to allow for morning warm up to bring the lowest zone temperature up to the occupancy setpoint.

Free Cooling: Disabled

Mechanical Cooling: Disabled

Global Ventilation Schedule: Disabled (outdoor dampers are closed)

3.8.5. Occupied Mode:

Time of day schedule, which starts the HVAC unit(s) along with an Optimum Start program usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule, Standby Occupancy Mode or Unoccupied Mode.

Global Ventilation Schedule: Enabled

AHU HVAC unit fan status confirmed by current sensing device(s) or VFD feedback.

Fan operation: The supply fan and return fan (where applicable) run continuously.

Room Heating Temperature Setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)

Room Free Cooling Enabled Temperature Setpoint nominal 22.5 °C +/-1.0°C

Room mechanical cooling temperature setpoint nominal 24.5 °C +/- 1.0°C (adjustable)

Supply and return fans run continuously.

Supply air temperature sensor operates the heating valve (or stages of gas heating or modulating gas heating where applicable), the mixing dampers (for free cooling) and the chilled water valve (or stages of DX cooling where applicable) in sequence to maintain the Supply Air Temperature Setpoint

Supply air static pressure sensor controls the supply VFD fan speed to maintain the Supply Air Static Setpoint

3.8.6. Standby Occupancy Mode:

Time of day schedule controls the AHU HVAC unit(s) usually between 4:00 p.m. and 11:00 p.m. Monday to Friday. (Between Occupied and Unoccupied Modes.)

Minimum outdoor air is set to zero when the global ventilation schedule is off).

Fan operation: Supply fan and return fan (where applicable) runs only on a call from heating or cooling only.

Ventilation normally set to zero (with a future provision to adjust).

Room heating temperature setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)

Room Mechanical Cooling temperature setpoint nominal 24.5 °C +/- 1.0°C (adjustable)

Free Cooling: Disabled

Mechanical Cooling: Enabled (Enabled when within the applicable limits and safeties)

3.8.7. Ventilation Lockout (Sequence):

When the ventilation lockout switch, usually located in the Custodial Office, is engaged, all outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode of operation.

When the ventilation lockout switch is disengaged, systems return to mode of operation based on the time of day schedule.

3.8.8. Supply Air Temperature Setpoint:

The Supply Air Temperature Setpoint is reset between 13 °C to 16 °C as the outside air temperature falls from 22 °C to 10 °C.

The Supply Air Temperature Setpoint is also reset +/-5 °C based on the VAV box requiring the most cooling (based on the maximum of all the Cooling PIDs of the VAV boxes (with 10 minute ramping) associated with the VAV fan system).

The Supply Air Temperature Setpoint is limited to a range of 12 °C to 20 °C.

3.8.9. Supply Air Static Pressure Setpoint:

The Supply Air Static Setpoint which is reset between 200 Pa and 300 Pa as the outside air temperature rises from -10 °C to 25°C.

3.8.10. Heating Sequence:

3.8.10.1. Default Setpoint:

When the Heating Mode is active, the Supply Air Temperature Setpoint remains unchanged.

3.8.10.2. Call for Heating:

Mechanical heating is used until the heating calls (from room controller PID, typically stage 1 heating is enabled at 25 %Clg PID signal and disabled at 50 %Clg PID signal and stage 2 heating is enabled at 5 %Clg PID signal and disabled at 25 %Clg PID signal or Night Setback thresholds) are satisfied.

Natural Gas

For Modulating Burners, (where applicable) 0 % signal (0 Volts) heating discharge temperature setpoint is at minimum discharge temperature (typically set on the rooftop unit to 17 °C). A 100% signal (10 Volts) heating discharge temperature setpoint is at maximum discharge temperature setpoint (typically set on the rooftop unit to 35 °C).

The room temperature sensor regulates heating output to maintain the occupied heating setpoint. Local setpoint adjustment is provided. The power exhaust fan or return fan (if applicable) cycles based on the rooftop economizer position.

Hydronic

For units with Heating Valves, (where applicable) 0 % signal (10 Volts) closes the heating valve. A 100% signal (below 2 Volts) opens the heating valve. (Note: The heating valve is reverse acting to the controller output signal and is to fail safe open) The heating coil circulating pump (where applicable) runs continuously in winter.

Radiation Zone

Where there is a zone served by radiation, the radiation valve opens (where applicable) and is to be substituted as the first stage of heating.

Supplemental Electric Space Heating

Where there is a zone supplemented by electric space heating, the electric heater starts (where applicable) and is to be utilized as the second stage of heating.

3.8.11. Mechanical Cooling Sequence:

3.8.11.1. Default Setpoint:

When the Cooling Mode is active, the Supply Air Temperature Setpoint remains unchanged.

3.8.11.2. Call for Cooling:

When Free Cooling is available, and a demand for cooling is in place, free cooling will be used first, and if the demand for cooling is still in place, mechanical cooling will be used until the supply air temperature cooling calls (from supply air controller PID, typically stage 1 cooling is enabled at 65 %Clg PID signal and disabled at 60 %Clg PID signal and stage 2 cooling is enabled at 95 %Clg PID signal and disabled at 60 %Clg PID signal) are satisfied.

The supply air temperature sensor also modulates the mixing dampers (for free cooling) to maintain the occupied free cooling setpoint.

Chilled Water Cooling

For units with Cooling Valves, (where applicable) 0 % signal (0 Volts) closes the cooling valve. A 100% signal (10 Volts) opens the cooling valve. (Note: The cooling valve is direct-acting to the controller output signal and is to fail safe closed) .

3.8.12. Economizer Operation (Free Cooling) and Carbon Dioxide Demand Control Ventilation:

3.8.13. Default Room Temperature Setpoint

When the Free Cooling Mode is active, the Supply Air Temperature Setpoint remains unchanged.

3.8.13.1. Minimum Outdoor Air Damper Position

A typical value for minimum outdoor air damper position is 10 % outdoor air, (0 % when an associated stand alone ERV is present) which can vary based on use case of the occupied space based on ASHRAE 62.1 net occupiable floor area outdoor air rate.

Minimum outdoor air damper position signal may exceed the economizer signal.

3.8.13.2. Economizer Operation

The outdoor air mixing dampers will be set to the minimum outdoor air position unless otherwise required under ASHRAE 62.1 Ventilation Rate Procedure - net occupiable floor area outdoor air rate (w/ CO₂ demand controlled ventilation reset).

If Free Cooling is enabled during Occupied Mode, economizer operation will be substituted for first stage mechanical cooling, the mixing dampers will be modulated open on a call for cooling to provide 'free' cooling.

For air handling units with power exhaust (where applicable), the exhaust fan runs when the outdoor air damper is more than 50 % open

3.8.13.3. During morning warm-up, the outdoor air minimum position is set to zero.

3.8.13.4. During Unoccupied Mode and Standby Occupancy Mode, free cooling is unavailable.

3.8.13.5. Each return air duct-mounted or space mounted CO₂ sensor acts as a high limit and will increase the amount of minimum outdoor air, to a maximum of 40 % outdoor air as the CO₂ level increases from 1000 ppm to 1200 ppm over a ramped 15 minute period). CO₂ levels are automatically logged at 10 minute intervals

3.8.13.6. Additional Rooms Partition Switch

Any additional room(s) (ie. Music Rooms) that are separated by a partition wall, will disable mechanical cooling (where applicable) for the associated units that serve the additional room(s). If the Music Room wall is open to the Gym, mechanical cooling serving the Music Room is disabled. Partition switch and lamacoid label to be provided above Music Room Sensor by the Building Automation Contractor. Label to read "No Cooling when Partition is Open to Gym".

3.8.14. Limits and Safeties

3.8.14.1. The maximum outdoor air damper position is limited based on the outdoor air temperature to prevent excessively low supply air temperature during startup. At -20 °C outdoor air temperature, and below, the maximum outdoor air damper position will be 0% open and at 10 °C outdoor air temperature the maximum outdoor air damper position will be 100 %.

3.8.14.2. The maximum outdoor air damper position is limited based on the outdoor air temperature to prevent excessively high supply air temperature. At 30 °C outdoor air temperature and above, the maximum outdoor air damper position will be 0% open and at 10°C outdoor air temperature, the maximum outdoor air damper position will be 100%

3.8.14.3. The mixed air temperature sensor acts as a low limit to ensure temperature does not fall below setpoint (typically 11 °C). In applications where the mixed air sensor is located after the DX cooling coil, the setpoint is reduced (to typically 5 °C) when DX cooling is enabled

- 3.8.14.4. The duct mounted supply air temperature sensor acts as a high limit for each stage of heating (for stage 1: disable above 60 °C, and enable below 50 °C, for stage 2: disable above 55 °C and enable below 45 °C) and a low limit for each stage of cooling (for stage 1: disable DX1 below 5 °C and enable DX1 above 10 °C, for stage 2: below 8 °C disable DX2 and above 13 °C enable DX2).
- 3.8.14.5. The duct/unit mounted supply air temperature sensor acts as a software freezestat (triggered below 1°C after 30 seconds, restored above 5 °C after 5 minutes).
- 3.8.14.6. The supply fan has a delay-off time of 90 seconds.
- 3.8.14.7. The DX cooling has a minimum-off time of 5 minutes.
- 3.8.14.8. DX cooling is disabled when the outdoor air temperature is below global DX disable setpoint (typically 2 °C below Cooling Enable setpoint) or when fan is off.
- 3.8.14.9. Gas heating is disabled when the outdoor air temperature is above the global heating disable setpoint (typically 2 °C above Heating Enable setpoint) or when the fan is off.
- 3.8.14.10. Stage 1 gas heating (where applicable for units with multiple stages of heating) has a minimum run time of 3 minutes.
- 3.8.14.11. The default zone setpoint is increased by 3°C when mechanical cooling is enabled (providing heating is disabled). The standard mechanical cooling setpoint will be limited to a (minimum of 23.5 °C - adjustable).
- 3.8.14.12. When the ventilation lockout switch (usually located at the custodial office) is engaged, the outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode.
- 3.8.14.13. Minimum outdoor air is provided when enabled by the Global Ventilation Schedule.
- 3.8.14.14. The return air carbon dioxide sensor acts as a high limit to increase the amount of minimum outdoor air from 0 to 40 % as the reading increases from 1000 ppm to 1200 ppm.
- 3.8.14.15. Cooling cannot turn on until heating has been off for a minimum of 5 minutes.
- 3.8.14.16. During Occupied Mode, and the outdoor air is above -1 °C, heating stage 2 (where applicable) has a delay-on time of 15 minutes, except when the outdoor air temperature is below -3 °C with a +2 °C deadband.
- 3.8.14.17. Minimum outdoor air is set to zero when the global ventilation schedule is off.
- 3.8.14.18. Mixed air low pressure switch shuts down the fans if the pressure falls below setpoint.
- 3.8.14.19. Supply air high pressure switch shuts down the fans if the pressure exceeds the setpoint.
- 3.8.14.20. A supply air static pressure high limit control is provided (initially set at 400 Pa).
- 3.8.14.21. Mixed air sensor acts as a low limit to prevent the mixed air temperature from falling below setpoint (initially 12 °C).
- 3.8.14.22. The heating coil pump turns off when the outside air temperature exceeds the heating disable setpoint (60 s delay-off time).
- 3.8.14.23. The fan drives will not exceed 60 % until the supply air static pressure exceeds 25 Pa (to ensure a smooth start-up).
- 3.8.14.24. As the %OA increases from 0 % to 15 % the return fan speed drops from 100 % to 90 % of the supply fan speed.
- 3.8.14.25. The outdoor air damper shuts if the hydronic heating coil pump status is not running when required.

3.8.15. Alarms:

An alarm will be generated upon the following conditions:

- 3.8.15.1. Fan status does not match the start/stop signal.
- 3.8.15.2. Mixed air temperature too high alarm (triggered above 50 °C and restored below 48 °C) or too low alarm (triggered below 5 °C and restored above 7 °C). Low mixed air temperature alarm set to lower thresholds when Mixed Air Temperature sensor is installed after the DX or cooling coil.
- 3.8.15.3. Supply air temperature too high alarm (triggered above 65 °C and restored below 63 °C) or too low alarm (triggered below 5 °C and restored above 7 °C)
- 3.8.15.4. Space temperature too high alarm (triggered above 42 °C and restored below 40 °C) for non-cooling systems, (triggered above 38 °C and restored above 36 °C) for cooling systems.
- 3.8.15.5. Space temperature too low alarm (triggered below 14 °C and restored above 16 °C).
- 3.8.15.6. Weekly fan runtime limit exceeded.
- 3.8.15.7. Return air carbon dioxide too high alarm (triggered above 1700 ppm and restored below 1650 ppm) or too low alarm (triggered below 250 ppm and restored above 300 ppm) with a 15 minute delay.
- 3.8.15.8. Software freezestat tripped.
- 3.8.15.9. High supply air static pressure alarm (triggered 30% above setpoint and restored 10% above setpoint) or low supply air static pressure alarm (triggered 30% below setpoint and restored 10% above setpoint).
- 3.8.15.10. Low return air temperature alarm (triggered below 14 °C and restored above 15 °C) or high return air temperature alarm (triggered above 40 °C and restored below 38 °C).
- 3.8.15.11. Freezestat or differential pressure limit switch tripped.
- 3.8.15.12. Hydronic heating pump status does not match the start/stop signal.

3.8.16. VAV Box Sequence of Operations:

Each VAV box mode of operation tracks with its associated VAV Fan System mode of operation. The duct supply air temperature is sent to each associated VAV box and is used by the VAV box along with the space temperature to determine air flow setting in each mode of operation. Each VAV box (unless otherwise noted) has a space temperature sensor with setpoint adjust and push button override. Each VAV box reports its cooling demand back to its associated VAV fan system to reset the supply air temperature setpoint.

3.8.16.1. Fan Powered VAV Box (with reheat coil / radiant panel)

The space temperature sensor modulates the VAV box (between minimum and maximum air flow settings) in sequence with the reheat coil and/or radiant panel (if applicable) to maintain setpoint. A velocity sensor controls the air flow between minimum and maximum settings. The minimum air flow setting is adjusted based on the need for reheat.

The fan runs continuously during occupied periods and the reheat valve modulates. Fans start 5 minutes before the air handling unit starts. When the central system is off, the primary air damper is closed. When Unoccupied, the fan cycles as required (with the reheat valve open) to maintain the unoccupied setpoint.

Science / Art Rooms - When the local fume hood is energized, the minimum air flow setting is increased to 50 %. When the local room exhaust fan is energized, the VAV box opens to 100 % flow.

3.8.16.2. Damper-Only (no reheat or fan-powered box)

The space temperature sensor modulates the VAV box (between the minimum and maximum air flow settings) to maintain airflow setpoint. A velocity sensor controls the air flow between minimum and maximum air flow settings.

Science / Art Rooms - When the local fume hood is energized, the minimum air flow setting is increased to 50 %. When the local room exhaust fan is energized, the VAV box opens to 100 % flow.

3.8.16.3. Damper-Only (with reheat coil / radiation valve)

The space temperature sensor modulates the VAV box (between minimum and maximum air flow settings) in sequence with the reheat coil and/or radiant panel (if applicable) to maintain setpoint. A velocity sensor controls the air flow between minimum and maximum settings. The minimum air flow setting is adjusted based on the need for reheat.

Science / Art Rooms - When the local fume hood is energized, the minimum air flow setting is increased to 50 %. When the local room exhaust fan is energized, the VAV box opens to 100 % flow.

3.8.16.4. Fan Powered VAV Bypass / Dump Box (with reheat coil / radiant panel)

The space temperature sensor modulates the VAV box (air flow intake settings) in sequence with the reheat coil and/or radiant panel (if applicable) to maintain setpoint. A velocity sensor controls the intake air flow between minimum and maximum settings. The minimum air flow setting is adjusted based on the need for reheat. Return air is introduced into the return side of the box to balance the intake air flow so that the discharge air is constant.

The fan runs continuously during occupied periods and the reheat valve modulates. Fans start 5 minutes before the air handling unit starts. When the central system is off, the primary air damper is closed. When Unoccupied, the fan cycles as required (with the reheat valve open) to maintain the unoccupied setpoint.

Supplemental Electric Space Heating

Where there is a zone supplemented by electric space heating, the electric heater starts (where applicable) and is to be utilized as the second stage of heating.

Science / Art Rooms

When the local fume hood is energized, the minimum air flow setting is increased to 50 %. When the local room exhaust fan is energized, the VAV box opens to 100 % flow.

3.9. Multizone HVAC Sequence of Operations:

3.9.1. Discretionary Fire Alarm Shutdown Mode:

The supply fan is off, the return fan is off (where applicable) and power exhaust fan is off (where applicable), the outdoor air mixing dampers are in the 0% outdoor air position, heating is disabled and cooling is disabled. The zone dampers are in the 50 % cooling position. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal HVAC unit functions are auto restored on relay signal from the fire alarm panel reset.

3.9.2. Freeze-stat Shutdown Mode(s):

3.9.2.1. Software

The duct/unit mounted supply air temperature sensor acts as a software freeze-stat (triggered below 1 °C after 3 minute delay, restored above 5 °C after 3 minute delay and auto reset after 5 minute delay)

3.9.2.2. Hard-Wired

In addition BAS monitors status of the hard wired freeze-stat (provided by others, where applicable) that shuts down the AHU fan(s) and spring closes the outside air damper(s) if the air temperature leaving the heating coil falls below the freeze-stat setpoint.

3.9.3. Unoccupied Mode:

Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday.

The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes.

The system will cycle between Idle State, Heating State or Pushbutton Override States to meet the demands from each state and return to the Idle State when the demands are satisfied.

3.9.3.1. (Idle State)

The supply fan is off, the return fan is off (where applicable) power exhaust fan is off (where applicable), the Global Ventilation Schedule is disabled, the outdoor air mixing dampers are in the 0 % outdoor air position, heating is disabled and cooling is disabled. The zone dampers are in the 50 % cooling position.

3.9.3.2. (Heating State)

System cycles on a call for unoccupied heating

Supply fan cycles on, associated exhaust or return fan cycles on (where applicable).

A full call for (all stages or full heat modulation where applicable) heating until setpoint is reached.

For modulating burners, (where applicable) 0 % signal (0 Volts) heating discharge temperature setpoint is at minimum discharge temperature (typically set on the multizone unit to 17 °C). A 100 % signal (10 Volts) heating discharge temperature setpoint is at maximum discharge temperature setpoint (typically set on the multizone unit to 35 °C).

Associated zone damper(s) modulate to obtain setpoint.

Unoccupied Heating temperature nominally 16.0 °C space temperature setpoint with an increased space temperature setpoint to 17.0 °C at -10.0 °C Outdoor Air Temperature or lower and 18.0 °C at -20.0 °C Outdoor Air Temperature or lower (each adjustable)

Mechanical Cooling: Disabled

Free Cooling: Disabled

Global Ventilation Schedule: Disabled

3.9.3.3. (Push Button Override State)

The default room temperature setpoint remains unchanged.

Idle state of the unoccupied mode is exited if the override pushbutton is pressed, (for a minimum of 2 seconds) at any room sensor. The associated system will switch to the Occupied Mode for 2 hours (adjustable).

Free Cooling: Disabled

Mechanical Cooling: Enabled

Global Ventilation: Enabled

The system returns to idle state in the unoccupied mode after the 2 hours after the pushbutton trigger has elapsed.

3.9.4. Morning Warmup Mode:

An optimized start, based on the time of day schedule, outdoor air temperature and the lowest indoor zone temperature is provided for heating.

The Global Ventilation Schedule is disabled. The supply fan is on, the return fan is on (where applicable), the outdoor air mixing dampers are in the 0 % outdoor air position, heating is enabled at full capacity and the cooling is disabled.

The zone dampers modulate to maintain space temperature.

The optimized start program is to begin up to 105 minutes (adjustable) before the occupancy schedule to allow for morning warm up to bring the lowest zone temperature up to occupancy setpoint.

Free Cooling: Disabled

Mechanical Cooling: Disabled

Global Ventilation Schedule: Disabled

The system exits Morning Warm Up Mode and continues into occupied mode when the lowest indoor zone temperature is warmed up to default room temperature setpoint.

3.9.5. Occupied Mode:

Time of day schedule, which starts the unit along with an Optimum Start program usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule, Standby Occupancy Mode or Unoccupied Mode.

Global Ventilation Schedule is enabled.

Unit fan status confirmed by current sensing device(s) or VFD feedback.

Fan operation: The supply fan and return fan (where applicable) run continuously.

Room heating temperature setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)

Room Free Cooling Enabled temperature setpoint nominal 22.5 °C +/-1.0 °C

Room mechanical cooling temperature setpoint nominal 24.5 °C +/- 1.0 °C (adjustable)

Global Ventilation Schedule: Enabled

3.9.6. Standby Occupancy Mode:

Time of day schedule starts the HVAC unit(s) usually between 4:00 p.m. and 11:00 p.m. Monday to Friday.

Minimum outdoor air is set to zero when the global ventilation schedule is off.

Fan operation: Supply fan and return fan (where applicable) runs only on a call from heating or cooling.

Ventilation normally set to zero (with a future provision to adjust).

Room heating temperature setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)

Room Mechanical Cooling temperature setpoint nominal 24.5 °C +/- 1.0 °C (adjustable)

Free Cooling: Disabled

Global Ventilation Schedule: Disabled

3.9.7. Zone Damper Control

3.9.8. The room temperature sensor modulates the zone damper to maintain the occupied room temperature setpoint. Local setpoint adjustment is provided

3.9.9. Ventilation Lockout (Sequence):

When the ventilation lockout switch, usually located in the Custodial Office, is engaged, all outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode of operation.

3.9.10. Heating Sequence:

3.9.10.1. Outdoor Air Temperature used to determine Heating Enable Mode:

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the heating enable mode based on the Outdoor Air Temperature below the threshold. The threshold is further adjusted by a calendar schedule. Typical default values are: 16 °C from September to May and 5 °C from June to August.

3.9.10.2. Default Setpoint:

When the Heating Mode is active, the default room temperature setpoint remains unchanged.

3.9.10.3. Call for Heating:

3.9.10.4. Hot Deck

Mechanical heating is used until the heating calls (from hot deck controller PID or Night Setback thresholds) are satisfied. For Modulating Burners, (where applicable) 0 % signal (0 Volts) heating discharge temperature setpoint is at minimum hot deck temperature (typically set on the rooftop unit to 17 °C). A 100% signal (10 Volts) heating discharge temperature setpoint is at maximum hot deck temperature setpoint (typically set on the rooftop unit to 35 °C).

The hot deck temperature sensor regulates heating output to maintain the hot deck heating setpoint.

The power exhaust fan or return fan (if applicable) cycles based on the rooftop economizer position.

The hot deck sensor resets the setpoint of the burner controller (modulating burner controlled by the rooftop unit heating controller according to hot deck temperature) based on the coldest zone deviation from setpoint as follows:

Deviation Hot Deck Setpoint

0.0 °C Minimum (17 °C)

-2.0 °C Maximum (35 °C)

Hydronic

For Heating Valve, (where applicable) 0 % signal (10 Volts) closes the heating valve. A 100 % signal (below 2 Volts) opens the heating valve.

Radiation Zone

Where there is a zone served by radiation, the radiation valve opens (where applicable) and is to be substituted as the first stage of heating.

Supplemental Electric Space Heating

Where there is a zone supplemented by electric space heating, the electric heater starts (where applicable) and is to be utilized as the second stage of heating.

3.9.11. Cooling Sequence:

3.9.11.1. Outdoor air temperature used to determine cooling enable mode:

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the cooling enable mode based on the outdoor air temperature exceeding the threshold. The threshold is further adjusted by a calendar schedule. Typical default values are: 18 °C from September to May and 21 °C from June to August.

3.9.11.2. Default Setpoint:

When the cooling enable mode is active, the default room temperature setpoint is raised by 3 °C.

3.9.11.3. Call for Cooling:

3.9.11.4. Cold Deck

When free cooling is available, and a demand for cooling is in place, free cooling will be used first, and if the demand for cooling is still in place, mechanical cooling will be used until the cooling calls (from cold deck controller PID) are satisfied.

The cold deck temperature sensor also modulates the mixing dampers (for free cooling) to maintain the cold deck setpoint.

The cold deck temperature sensor modulates the mixing dampers to maintain the cold deck setpoint which is reset based on the warmest zone deviation from setpoint as follows:

Deviation Cold Deck Setpoint

0.5 °C 20 °C

2 °C 13 °C

Zone Damper Control:

(same as heating sequence) The room temperature sensor modulates the zone damper to maintain the occupied room temperature setpoint.

3.9.12. Ventilation Sequence:

Not applicable as hot deck and cold deck temperatures are maintained to setpoint simultaneously.

3.9.13. Economizer Operation (and CO₂ Demand Control Ventilation) :

- 3.9.13.1. During Occupied Mode, economizer operation will be substituted for first stage mechanical cooling when the outdoor air temperature and relative humidity are below the Free Cooling Setpoint Sequence of Operation. If the outdoor air temperature is below this free cooling setpoint the mixing dampers will be modulated open on a call for cooling to provide 'free' cooling.
- 3.9.13.2. Minimum outdoor air damper position signal may exceed the economizer signal. A typical value for minimum outdoor air damper position is 5 % outdoor air, (0 % when an associated stand alone ERV is present) which can vary based on use case of the occupied space based on ASHRAE 62.1 net occupiable floor area outdoor air rate.
- 3.9.13.3. For units with power exhaust, the exhaust fan runs when the outdoor air damper is more than 50 % open.
- 3.9.13.4. During morning warm-up, the outdoor air minimum position is set to zero.
- 3.9.13.5. During Unoccupied Mode and Standby Occupancy Mode, free cooling is unavailable.
- 3.9.13.6. During Occupied Mode, If the outdoor air temperature and relative humidity are above the Free Cooling Setpoint Sequence of Operation, the mixing dampers will be set to the minimum outdoor air threshold unless otherwise required under ASHRAE 62.1 Ventilation Rate Procedure - net occupiable floor area outdoor air rate (w/ CO₂ demand controlled ventilation reset).
- 3.9.13.7. Each return air duct-mounted or space mounted CO₂ sensor acts as a high limit and will increase the amount of minimum outdoor air, to a maximum of 40 % outdoor air as the CO₂ level increases from 1000 ppm to 1200 ppm over a ramped 15 minute period).
- 3.9.13.8. CO₂ levels are automatically logged at 10 minute intervals (adjustable).

3.9.14. Additional Rooms Partition Switch

Any additional room(s) (i.e. Music Rooms) that are separated by a partition wall, will disable mechanical cooling (where applicable) for the associated units that serve the additional room(s). If the Music Room wall is open to the Gym, mechanical cooling serving the Music Room is disabled. Partition switch and lamacoid label to be provided above Music Room Sensor by the Building Automation Contractor. Label to read "No Cooling when Partition is Open to Gym".

3.9.15. Limits and Safeties

- 3.9.15.1. The maximum outdoor air damper position is limited based on the outdoor air temperature to prevent excessively low supply air temperature. At -15 °C or below, outdoor air temperature, the maximum outdoor air damper position will be 0 % open and at 10 °C outdoor air temperature, the maximum outdoor air damper position will be 100 %.
- 3.9.15.2. The maximum outdoor air damper position is limited based on the outdoor air temperature to prevent excessively high supply air temperature. At 30 °C outdoor air temperature and above, the maximum outdoor air damper position will be 0 % open and at 10 °C outdoor air temperature, the maximum outdoor air damper position will be 100 %
- 3.9.15.3. The mixed air temperature sensor acts as a low limit to ensure temperature does not fall below setpoint (typically 11 °C). In applications where the mixed air sensor is located after the DX cooling coil, the setpoint is reduced (to typically 5 °C) when DX cooling is enabled.
- 3.9.15.4. The hot deck air temperature sensor acts as a high limit for each stage of heating (for stage 1: disable above 60 °C , and enable below 50 °C, for stage 2: disable above 55 °C and enable below 45 °C) and the cold deck air temperature sensor a low limit for each stage of cooling (for stage 1: disable DX1 below 5°C and enable DX1 above 10 °C, for stage 2: below 8 °C disable DX2 and above 13 °C enable DX2).
- 3.9.15.5. The hot deck air temperature sensor acts as a software freezestat (triggered below 1 °C for 3 minutes, restored above 5 °C for 3 minute) auto reset after 5 minute delay.
- 3.9.15.6. The supply fan has a delay-off time of 90 seconds.
- 3.9.15.7. The DX cooling has a minimum-off time of 5 minutes.
- 3.9.15.8. DX cooling is disabled when the outdoor air temperature is below global DX disable setpoint (typically 2 °C below Cooling Enable setpoint) or when fan is off.
- 3.9.15.9. Gas heating is disabled when the outdoor air temperature is above the global heating disable setpoint (typically 2 °C above Heating Enable setpoint) or when the fan is off.
- 3.9.15.10. Stage 1 gas heating (where applicable for units with multiple stages of heating) has a minimum run time of 3 minutes.
- 3.9.15.11. Cooling cannot turn on until heating has been off for a minimum of 5 minutes.
- 3.9.15.12. During Occupied Mode, and the outdoor air is above -1 °C, heating stage 2 (where applicable) has a delay-on time of 15 minutes, except when the outdoor air temperature is below -3 °C with a +2 °C deadband.
- 3.9.15.13. The default zone setpoint is increased by 3°C when mechanical cooling is enabled (providing heating is disabled). The standard mechanical cooling setpoint will be limited to a (minimum of 23.5 °C - adjustable).
- 3.9.15.14. When the ventilation lockout switch (usually located at the custodial office) is engaged, the outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode.
- 3.9.15.15. Minimum outdoor air is provided when enabled by the Global Ventilation Schedule.

- 3.9.15.16. The return air carbon dioxide sensor acts as a high limit to increase the amount of minimum outdoor air from 0 to 40 % as the reading increases from 1000 ppm to 1200 ppm.
- 3.9.15.17. Cooling cannot turn on until heating has been off for a minimum of 5 minutes.
- 3.9.15.18. During Occupied Mode, and the outdoor air is above -1°C, heating stage 2 (where applicable) has a delay-on time of 15 minutes, except when the outdoor air temperature is below -3°C with a +2°C deadband.
- 3.9.15.19. Minimum outdoor air is set to zero when the Global Ventilation Schedule is off.

3.9.16. Alarms:

An alarm will be generated upon the following conditions:

- 3.9.16.1. Fan status does not match the start/stop signal.
- 3.9.16.2. Mixed air temperature too high alarm (triggered above 50 °C and restored below 48 °C) or too low alarm (triggered below 5 °C and restored above 7 °C). Low mixed air temperature alarm set to lower thresholds when Mixed Air Temperature sensor is installed after the DX/cooling coil.
- 3.9.16.3. Hot deck air temperature too high alarm (triggered above 45 °C and restored below 43 °C) or sensor fault.
- 3.9.16.4. Cold deck air temperature too low alarm (triggered below 5 °C and restored above 7 °C) or sensor fault.
- 3.9.16.5. Zone temperature too high alarm (triggered above 42 °C and restored below 40 °C) for non-cooling systems, (triggered above 38 °C and restored below 36 °C) for cooling systems.
- 3.9.16.6. Zone temperature too low alarm (triggered below 14 °C and restored above 16°C).
- 3.9.16.7. Weekly fan runtime limit exceeded.
- 3.9.16.8. Return air CO₂ too high alarm (triggered above 1700 ppm and restored below 1650 ppm) or too low alarm (triggered below 250 ppm and restored above 300 ppm) with a 15 minute delay.
- 3.9.16.9. Software freezestat tripped.

3.10. Heat Pump Gas Fired Multi Zone Sequence of Operations

3.10.1. System Integration Guidelines:

3.10.1.1. Output Points

All CME multizone equipment points (fan speed, outdoor damper, heating, cooling, exhaust fans) are connected directly to the CME Multi Zone manufacturer's PMZ controller commanded indirectly through parameters via BACnet MS/TP.

3.10.1.2. Input Points:

Zone temperature, setpoint adjust, pushbutton overrides are provided by the Control Contractor, interfaced into the BAS system and the data is sent to the PMZ controller via BACnet MS/TP.

Supply air temperature, Return air temperature, Return Air Carbon Dioxide sensors, Fan Low Speed Status, Fan High Speed Status are connected directly to the Multi Zone manufacturer's PMZ controller. The data from the PMZ is read by the BAS via BACnet MS/TP).

3.10.1.3. Setpoints and Schedules

Setpoints and Schedules are determined as detailed in the following Sequence of Operations and are sent to the PMZ controller via BACnet MS/TP

3.10.2. Discretionary Fire Alarm Shutdown Mode:

The supply fans are off and power exhaust fans are off (where applicable), the outdoor air dampers are in the 0% outdoor air position, heating is disabled and cooling is disabled. The two-position zone dampers (where applicable) are in the closed position. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal HVAC unit functions are auto restored on relay signal from the fire alarm panel reset.

3.10.3. Freeze-stat Shutdown Mode(s):

3.10.3.1. Software

The duct/unit mounted supply air temperature sensor (connected to the Multizone manufacturer's PMZ controller and monitored via BACnet MS/TP) acts as a software freeze-stat (triggered below 1 °C after 1 minute delay, restored above 5 °C after 5 minute delay).

3.10.3.2. Hard-Wired

In addition BAS monitors status of the hard wired freeze-stat (provided by others, where applicable) that shuts down the AHU fan(s) and spring closes the outside air damper(s) if the air temperature leaving the heating coil falls below the freeze-stat setpoint.

3.10.4. Unoccupied Mode:

Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday.

The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes.

The system will cycle between Idle State, Heating State or Pushbutton Override States to meet the demands from each state and return to the Idle State when the demands are satisfied.

- 3.10.4.1. (Idle State)
The supply fan is off, the power exhaust fans are off (where applicable), the Global Ventilation Schedule is disabled, the outdoor air dampers are in the 0 % outdoor air position, heating is disabled and cooling is disabled. The two-position zone dampers are in the closed position.
- 3.10.4.2. (Heating State)
System cycles on a call for unoccupied heating (which is triggered by the System Minimum Zone Temperature falling below the Unoccupied Heating Room Setpoint).
Supply fan cycles on..
A full call for (all stages or full heat modulation where applicable) heating until setpoint is reached.
Unoccupied Heating Room Temperature Setpoint nominally 16.0 °C space temperature setpoint with an increased space temperature setpoint to 17.0 °C at -10.0 °C Outdoor Air Temperature or lower and 18.0 °C at -20.0 °C Outdoor Air Temperature or lower (each adjustable).
The outdoor air temperature is also used to determine the heat-pump heating enable point. Below the heat-pump enable outdoor air temperature setpoint the heating is provided by gas fired heating.
Mechanical Cooling: Disabled
Free Cooling: Disabled
Global Ventilation Schedule: Disabled
- 3.10.4.3. (Push Button Override State)
The default room temperature setpoint remains unchanged.
Idle state of the unoccupied mode is exited if the override pushbutton is pressed, (for a minimum of 2 seconds) at any room sensor. The associated system will switch to the Occupied Mode for 2 hours (adjustable).
Free Cooling: Disabled
Mechanical Cooling: Enabled
Global Ventilation: Enabled
The system returns to idle state in the unoccupied mode after the 2 hours after the pushbutton trigger has elapsed.
- 3.10.5. Morning Warmup Mode:
An optimized start, based on the time of day schedule, outdoor air temperature and the lowest indoor zone temperature is provided for heating.
The Global Ventilation Schedule is disabled. The furnace supply fans are on (at high speed when heating is required), the outdoor air mixing dampers are in the 0 % outdoor air position, heating is enabled and the cooling is disabled.
The zone dampers open (where applicable) to maintain space temperature.
The optimized start program is to begin up to 105 minutes (adjustable) before the occupancy schedule to allow for morning warm up to bring the lowest zone temperature up to occupancy setpoint.
Free Cooling: Disabled
Mechanical Cooling: Disabled
Global Ventilation Schedule: Disabled
The system exits Morning Warmup Mode and continues into occupied mode when the lowest indoor zone temperature is warmed up to default room temperature setpoint.
- 3.10.6. Occupied Mode:
Time of day schedule, which starts the unit along with an Optimum Start program usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule, Standby Occupancy Mode or Unoccupied Mode.
Global Ventilation Schedule is enabled.
Unit fan status confirmed by current sensing device(s) or VFD feedback.
Fan operation: The supply fan runs continuously and the exhaust fans stage on as required.
Room heating temperature setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)
Room Free Cooling Enabled temperature setpoint nominal 22.5 °C +/-1.0 °C
Room mechanical cooling temperature setpoint nominal 24.5 °C +/- 1.0 °C (adjustable)
Global Ventilation Schedule: Enabled
- 3.10.7. Standby Occupancy Mode:
Time of day schedule starts the HVAC unit(s) usually between 4:00 p.m. and 11:00 p.m. Monday to Friday.
Minimum outdoor air is set to zero (with future provision to adjust) when the global ventilation schedule is off. .
Ventilation normally set to zero (with a future provision to adjust).
Room heating temperature setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)
Room Mechanical Cooling temperature setpoint nominal 24.5 °C +/- 1.0 °C (adjustable)
Free Cooling: Disabled
Global Ventilation Schedule: Disabled

- 3.10.8. Zone Damper Control
The zone temperatures are monitored and sent to the manufacturer supplied PMZ controller.
Zone space temperature sensors open their respective two-position zone damper (where applicable) to maintain setpoint. An adjustment of +/-1°C is provided at each room temperature sensor. The default space temperature setpoint is raised 3 °C when DX cooling is enabled.
The zone dampers are set to minimum ventilation air flow by the balancer when 'closed'. To maintain minimum ventilation air during Occupied Mode
- 3.10.9. Ventilation Lockout (Sequence):
When the ventilation lockout switch, usually located in the Custodial Office, is engaged, all outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode of operation.
- 3.10.10. Heating Sequence:
- 3.10.10.1. Outdoor Air Temperature used to determine Heating Enable Mode:
A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the heating enable mode based on the Outdoor Air Temperature below the threshold. The threshold is further adjusted by a calendar schedule.
Typical default values are: 16 °C from September to May and 5 °C from June to August.
The outdoor air temperature is also used to determine the heat-pump heating enable point. Below the heat-pump enable outdoor air temperature setpoint the heating is provided by gas fired heating.
- 3.10.10.2. Default Setpoint:
When the Heating Mode is active, the default room temperature setpoint remains unchanged.
- 3.10.10.3. Call for Heating:
- 3.10.10.4. Dedicated Furnace
The furnace fan goes into high speed during heating mode.
Mechanical heating is used until the heating calls (from Furnace controller PID or Night Setback thresholds) are satisfied.
Condensers act as heat pumps and provide heating until outside air temperature falls below 5 °C (Adjustable based on defrost operation).
Below this heat-pump outdoor air temperature setpoint the gas heating is used to provide heating.
Radiation Zone
Where there is a zone served by radiation, the radiation valve opens (where applicable) and is to be substituted as the first stage of heating.
Supplemental Electric Space Heating
Where there is a zone supplemented by electric space heating, the electric heater starts (where applicable) and is to be utilized as the second stage of heating.
- 3.10.11. Cooling Sequence:
- 3.10.11.1. Outdoor air temperature used to determine cooling enable mode:
A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the cooling enable mode based on the outdoor air temperature exceeding the threshold. The threshold is further adjusted by a calendar schedule. Typical default values are: 18 °C from September to May and 21 °C from June to August.
- 3.10.11.2. Default Setpoint:
When the cooling enable mode is active, the default room temperature setpoint is raised by 3 °C.
- 3.10.11.3. Call for Cooling:
- 3.10.11.4. Dedicated Furnace
The furnace fan goes into high speed during cooling mode.
When free cooling is available, and a demand for cooling is in place, free cooling will be used first, and if the demand for cooling is still in place, mechanical cooling will be used until the cooling calls controller PID are satisfied.
- Zone Damper Control:
The zone temperatures are monitored and sent to the manufacturer supplied PMZ controller.
Zone space temperature sensors open their respective two-position 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 3 °C when DX cooling is enabled.
- 3.10.12. Ventilation Sequence:
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.
- 3.10.13. Economizer Operation (and CO₂ Demand Control Ventilation):
- 3.10.13.1. During Occupied Mode, economizer operation will be substituted for first stage mechanical cooling when the outdoor air temperature and relative humidity are below the Free Cooling Setpoint Sequence of Operation. If the outdoor air temperature is below this free cooling setpoint the outdoor air dampers will be modulated open on a call for cooling to provide 'free' cooling.

- 3.10.13.2. Minimum outdoor air damper position signal may exceed the economizer signal. A typical value for minimum outdoor air damper position is 10 % outdoor air, (0 % when an associated stand alone ERV is present) which can vary based on use case of the occupied space based on ASHRAE 62.1 net occupiable floor area outdoor air rate.
- 3.10.13.3. For units with power exhaust, the exhaust fans stage on when the outdoor air damper is more than 50 % open.
- 3.10.13.4. During morning warm-up, the outdoor air minimum position is set to zero.
- 3.10.13.5. During Unoccupied Mode and Standby Occupancy Mode, free cooling is unavailable.
- 3.10.13.6. During Occupied Mode, If the outdoor air temperature and relative humidity are above the Free Cooling Setpoint, the mixing dampers will be set to the minimum outdoor air position unless otherwise required under ASHRAE 62.1 Ventilation Rate Procedure - net occupiable floor area outdoor air rate (w/ CO₂ demand controlled ventilation reset).
- 3.10.13.7. Each return air duct-mounted or space mounted CO₂ sensor acts as a high limit and will increase the amount of minimum outdoor air, to a maximum of 40 % outdoor air as the CO₂ level increases from 1000 ppm to 1200 ppm over a ramped 15 minute period).

- 3.10.14. Additional Rooms Partition Switch
- 3.10.14.1. Any additional room(s) (i.e. Music Rooms) that are separated by a partition wall, will disable mechanical cooling (where applicable) for the associated units that serve the additional room(s). If the Music Room wall is open to the Gym, mechanical cooling serving the Music Room is disabled. Partition switch and lamacoid label to be provided above Music Room Sensor by the Building Automation Contractor. Label to read "No Cooling when Partition is Open to Gym"

- 3.10.15. Limits and Safeties
- 3.10.15.1. The maximum outdoor air damper position is limited based on the outdoor air temperature to prevent excessively low supply air temperature. At -15 °C or below, outdoor air temperature, the maximum outdoor air damper position will be 0% open and at 10 °C outdoor air temperature, the maximum outdoor air damper position will be 100 %.
- 3.10.15.2. The maximum outdoor air damper position is limited based on the outdoor air temperature to prevent excessively high supply air temperature. At 30 °C outdoor air temperature and above, the maximum outdoor air damper position will be 0% open and at 10 °C outdoor air temperature, the maximum outdoor air damper position will be 100 %
- 3.10.15.3. The supply air temperature sensor acts as a high limit for each stage of heating (for stage 1: disable above 60 °C, and enable below 50 °C, for stage 2: disable above 55 °C and enable below 45 °C) and the cold deck air temperature sensor a low limit for each stage of cooling (for stage 1: disable DX1 below 5°C and enable DX1 above 10 °C, for stage 2: below 8 °C disable DX2 and above 13 °C enable DX2).
- 3.10.15.4. The supply air temperature sensor acts as a software freezestat (triggered below 1 °C for 1 minute, restored above 5 °C for 1 minute) auto reset after 5 minute delay.
- 3.10.15.5. The supply fan has a delay-off time of 90 seconds.
- 3.10.15.6. The DX cooling has a minimum-off time of 5 minutes.
- 3.10.15.7. DX cooling is disabled when the outdoor air temperature is below global DX disable setpoint (typically 2 °C below Cooling Enable setpoint) or when fan is off.
- 3.10.15.8. Gas heating is disabled when the outdoor air temperature is above the global heating disable setpoint (typically 2 °C above Heating Enable setpoint) or when the fan is off.
- 3.10.15.9. Stage 1 gas heating (where applicable for units with multiple stages of heating) has a minimum run time of 3 minutes.
- 3.10.15.10. Cooling cannot turn on until heating has been off for a minimum of 5 minutes.
- 3.10.15.11. During Occupied Mode, and the outdoor air is above -1 °C, heating stage 2 (where applicable) has a delay-on time of 15 minutes, except when the outdoor air temperature is below -3 °C with a +2 °C deadband.
- 3.10.15.12. The default zone setpoint is increased by 3 °C when mechanical cooling is enabled (providing heating is disabled). The standard mechanical cooling setpoint will be limited to a (minimum of 23.5 °C - adjustable).
- 3.10.15.13. When the ventilation lockout switch (usually located at the custodial office) is engaged, the outdoor air dampers close, free cooling is disabled, and the system switches to Standby Occupancy Mode.
- 3.10.15.14. Minimum outdoor air is provided when enabled by the Global Ventilation Schedule.
- 3.10.15.15. The return air carbon dioxide sensor acts as a high limit to increase the amount of minimum outdoor air from 0 to 40 % as the reading increases from 1000 ppm to 1200 ppm.
- 3.10.15.16. During Occupied Mode, and the outdoor air is above -1°C, heating stage 2 (where applicable) has a delay-on time of 15 minutes, except when the outdoor air temperature is below -3°C with a +2°C deadband.
- 3.10.15.17. Minimum outdoor air is set to zero when the Global Ventilation Schedule is off.

- 3.10.16. Alarms:
- 3.10.16.1. An alarm will be generated upon the following conditions:
- 3.10.16.2. Fan status does not match the start/stop signal.
- 3.10.16.3. Supply air temperature too high alarm (triggered above 45 °C and restored below 43 °C) or sensor fault.
- 3.10.16.4. Supply air temperature too low alarm (triggered below 5 °C and restored above 7 °C) or sensor fault.
- 3.10.16.5. Zone temperature too high alarm (triggered above 42 °C and restored below 40 °C) for non-cooling systems, (triggered above 38 °C and restored below 36 °C) for cooling systems.
- 3.10.16.6. Zone temperature too low alarm (triggered below 14 °C and restored above 16°C).
- 3.10.16.7. Weekly fan runtime limit exceeded.

- 3.10.16.8. Return air CO₂ too high alarm (triggered above 1700 ppm and restored below 1650 ppm) or too low alarm (triggered below 250 ppm and restored above 300 ppm) with a 15 minute delay.
- 3.10.16.9. Software freezestat tripped.

3.11. **Hydronic Heating System with Non-Condensing Boiler Sequence of Operations:**

3.11.1. **System Enable/Disable Criteria for Winter Mode:**

Winter Mode is active between September 16 and May 15 (adjustable).

When Winter Mode is active the heating system is enabled no matter what the outdoor air temperature is so that a failure of the outdoor air temperature sensor or the networking of it to other controllers does not cause a no-heat condition.

Once the heating system is enabled, the sequence is followed starting with 3.10.4 Hot Water Supply Setpoint Determination.

3.11.2. **System Enable/Disable Criteria for Summer Mode:**

Summer Mode is active between May 16 and September 15 (adjustable)

The heating system is enabled when the outdoor air temperature is lower than 16 °C and disabled when the outdoor air temperature goes above 16 °C with a 2 °C deadband.

Once the heating system is enabled, the sequence is followed starting with 3.10.4 Hot Water Supply Setpoint Determination.

When the heating system is disabled in summer mode, the boilers, main and circulation pumps are shut off.

The primary heating pumps have a delay-off time of 5 minutes.

3.11.3. **Inter-boiler Runtime Delay:**

In winter mode the lead boiler must run at least 5 minutes before the next boiler can start.

In summer mode the delay is increased to 30 minutes.

3.11.4. **Hot Water Supply Temperature Setpoint Determination (outdoor reset schedule)**

The Hot Water Supply Temperature Setpoint is the sum of the Outdoor Air Temperature Reset calculation and the sum of the applicable offsets based on the current Mode of Operation.

General Equation:

Hot Water Supply Temperature Setpoint = Outdoor Air Temperature Reset Calculation + Return Water Temperature Offset + Morning Warm-Up Offset + Unoccupied Setback Offset + Minimum Zone Temperature Deviation Reset Offset

Resets and Offset Calculations:

Outdoor Air Temperature Reset Calculation: The Hot Water Supply Temperature Setpoint is reset from the outdoor air temperature as per the following linear reset schedule:

For non-condensing boilers:

<u>Outdoor Air Temperature (adjustable)</u>	<u>Heating Water Supply Temperature (adjustable)</u>
16 °C	60 °C
-20 °C	90 °C

Return Water Temperature Offset:

The hot water supply temperature setpoint is further offset +5 °C to maintain boiler entering water above 55 °C to minimize condensation:

<u>Heating Water Return Temperature</u>	<u>Heating Supply Water Temperature Offset</u>
52 °C	5 °C
55 °C	0 °C

Morning Warm-Up Temperature Offset:

The hot water supply temperature setpoint has a +10 °C offset (adjustable) added during morning warm-up mode.

Unoccupied Mode (active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday)

The hot water supply temperature setpoint is reduced by -5 °C (adjustable) for unoccupied and setback.

Minimum Zone Temperature Deviation Reset Offset:

The hot water supply temperature setpoint is also reset +/- 5 °C (linear reset) based on the minimum zone temperature deviation (adjacent group of hydronic heater / wing in the school) from setpoint when in Occupied Mode usually between 7:00 a.m. and 11:00 p.m. Monday to Friday.

3.11.5. **Unoccupied Mode:**

The heating system is in unoccupied mode when the Time Schedule is not in Occupied or Morning-Warm-Up Mode,

3.11.6. **Morning Warm-Up Mode:**

During the optimum start, the heating system will be in Morning Warm-Up Mode.

The optimized start program, based on outdoor air temperature and time of day schedule, is to begin up to 120 minutes (adjustable) before the occupancy schedule to allow for morning warm up.
The optimized start time is calculated based on how long the hot water supply temperature has historically taken to reach setpoint at the current outdoor air temperature.

3.11.7. Occupied Mode

The heating system is Occupied Mode as determined by the associated Time Schedule usually between 7:00 a.m. and 11:00 p.m. Monday to Friday.

Boilers are modulated by the BAS to maintain supply water temperature setpoint.

Boilers are cycled on a call from supply water temperature in sequence to maintain the Hot Water Supply Temperature Setpoint.

The control loop PID modulates or stages the boilers to maintain the Hot Water Supply Temperature at Setpoint. The PID output is divided into the number of boilers.

For 2 primary boilers, each boiler would operate with 50 % of the full 100 % of the PID % Htg output. There is a 300 second delay between stages. First the lead boiler, then the lag boiler, as the PID % Htg output increases. The lead and lag boilers are reassigned weekly to equalize run-time.

For 3 primary boilers: each boiler would operate through 33 % of the full 100 % of the PID Htg output. There is a 300 second delay between stages. First the lead boiler, then the lag1 boiler, then lag2 as the PID % Htg output increases. The lead and lag boilers are reassigned weekly to equalize run-time.

For 4 primary boilers: each boiler would operate through 25 % of the full 100 % of the PID % Htg output. There is a 300 second delay between stages. First the lead boiler, then the lag1 boiler, then lag2, then lag3 as the PID % Htg output increases. The lead and lag boilers are reassigned weekly to equalize run-time.

For systems with special purpose boilers such as:

a) one modulating boiler working with other on/off boilers: the modulating boiler would run to maintain setpoint when there is less than one boiler's output required to meet the heating load in order to reduce cycling of the boilers.

b) one condensing boiler working with other non-condensing boilers: the condensing boiler runs to increase low return water temperatures above the condensing temperature for the other boilers. If the condensing boiler fails or is taken out of service, the return water setpoint is adjusted up to avoid condensation in the other boilers.

3.11.8. Lead/Lag operation:

Provided for boilers on a weekly basis. Typically rotated on a Tuesday at 1:00 p.m. when a new lead boiler is assigned. The next lag boiler is to start should the Lead Boiler fail to start.

The boiler circulating pumps are hard wired by the Mechanical Contractor to the local boiler controls and flow switch(s) so that each boiler starts when the associated pump is confirmed running through the flow switch(s). The boiler circulating pump current draws are monitored by BAS to determine status.

3.11.9. Main Heating Pumps:

One of the main heating pumps will operate continuously when heat is enabled. They operate on a weekly lead/lag operation, typically rotated on a Thursday at 1:00 p.m. when a new lead pump is assigned. (Lag pump starts if lead pump fails or is in alarm mode)

Main heating pumps are monitored by BAS for status.

Main heating pumps are exercised to run for 10 minutes once a week, typically lead pump on a Thursday at 1:00 p.m. and lag pump at 1:30 p.m. when the system is off in summer mode.

3.11.10. Main Pump Modulated Flow:

The main heating pump speed (normally controlled by a VFD provided by others) is modulated to maintain the minimum differential pressures of the multiple sensors (where applicable) at the setpoint required for the individual heating loops.

3.11.11. Limits and Safeties:

3.11.11.1. The supply water temperature setpoint is limited to operate between 45 °C and 105 °C.

3.11.11.2. Summer mode delay shutdown. The primary heating pumps have a delay-off time of 5 minutes.

3.11.11.3. Minimum Boiler Runtime with Circulating Pump Interlock: Each boiler must run at least 2 minutes before it will modulate above the minimum firing rate. The boilers cannot modulate up from the minimum fire until the boiler circulating pump status is on.

3.11.11.4. Inter-boiler Runtime Delay: The lead boiler must run at least 5 minutes before the next boiler can start. The delay is increased to 30 minutes when switching from summer to winter operation.

3.11.12. Alarms:

3.11.12.1. Hot water supply temperature too high alarm (triggered above 12 °C deviation from setpoint after a 600 second time delay and restored below 10 °C deviation from setpoint).

3.11.12.2. Hot water supply temperature too low alarm (triggered below -12 °C deviation from setpoint after a 300 second time delay and restored above -10 °C deviation from setpoint). (Alarm is routed to Heat Loss Alarm for notification of security staff).

3.11.12.3. Boiler alarm in an incorrect state (separate alarm for each boiler).

- 3.11.12.4. Any pump in an incorrect state after a 300 second time delay (separate alarm for each pump).
- 3.11.12.5. Any VFD alarm (separate alarms for each VFD).
- 3.11.12.6. Differential water pressure too high alarm (triggered above 5 psi deviation from setpoint after a 600 second delay and restored below 3 psi deviation from setpoint) or too low alarm (triggered below -5 psi deviation from setpoint after a 300 second delay and restored above -3 psi deviation from setpoint) (separate alarm for each differential water pressure).

3.12. Hydronic Heating System with Condensing Boilers Sequence of Operations:

3.12.1. System Enable/Disable Criteria for Winter Mode:

Winter Mode is active between September 16 and May 15.

When Winter Mode is active the heating system is enabled no matter what the outdoor air temperature . A failure of the outdoor air temperature sensor or the networking of it to other controllers does not cause a no-heat condition.

The boilers operate when heating is enabled.

When heating is enabled the lead primary heating pump runs. (See the lead/lag heating pump sequence.)

Once the heating system is enabled, the sequence is followed starting with 3.11.4 Hot Water Supply Setpoint Determination.

3.12.2. System Enable/Disable Criteria for Summer Mode:

Summer Mode is active between May 16 and September 15.

The heating system is enabled when the outdoor air temperature is lower than 4 °C and disabled when the outdoor air temperature goes above 4 °C with a 2 °C deadband.

Once the heating system is enabled, the sequence is followed starting with 3.11.4 Hot Water Supply Setpoint Determination.

When the heating system is disabled in summer mode, the boilers, main and circulation pumps are shut off.

The primary heating pumps have a delay-off time of 5 minutes.

3.12.3. Changeover from Summer to Winter Mode:

Inter-boiler Runtime Delay: The lead boiler must run at least 5 minutes before the next boiler can start.

The delay is increased to 30 minutes when switching from summer to winter operation.

3.12.4. Hot Water Supply Temperature Setpoint Determination

The Hot Water Supply Temperature Setpoint is the sum of the Outdoor Air Temperature Reset calculation and the sum of the applicable offsets based on the current Mode of Operation.

General Equation:

Hot Water Supply Temperature Setpoint = Outdoor Air Temperature Reset Calculation + Return Water Temperature Offset + Morning Warm-Up Offset + Unoccupied Setback Offset + Minimum Zone Temperature Deviation Reset Offset

Resets and Offset Calculations:

Outdoor Air Temperature Reset Calculation: The Hot Water Supply Temperature Setpoint is reset from the outdoor air temperature as per the following linear reset schedule (adjustable):

<u>Oat</u>	<u>HwstSp</u>
16 °C	55 °C
-20 °C	90 °C

Return Water Temperature Offset:

The hot water supply temperature setpoint is further offset +5 °C to maintain boiler entering water below 55 °C to maximize condensation:

<u>Hwrt</u>	<u>HwstSpAdd</u>
52 °C	0 °C
55 °C	-5 °C

Morning Warm-Up Temperature Offset:

The hot water supply temperature setpoint has a +10 °C offset added during morning warm-up mode.

Unoccupied Setback Offset:

The hot water supply temperature setpoint is reduced by -5 °C for unoccupied setback.

Minimum Zone Temperature Deviation Reset Offset:

The hot water supply temperature setpoint is also reset +/- 5 °C based on the minimum zone temperature deviation from setpoint when in Occupied Mode.

3.12.5. Unoccupied Mode:

The heating system is in unoccupied mode when the Time Schedule is not in Occupied or Morning-Warm-Up Mode,

3.12.6. Morning Warm-Up Mode:

During the optimum start, the boiler system system will be in Morning Warm-Up Mode.

The optimized start program, based on outdoor air temperature and time of day schedule, is to begin up to 120 minutes (adjustable) before the occupancy schedule to allow for morning warm up.

The optimized start time is calculated based on how long the hot water supply temperature has historically taken to reach setpoint at the current outdoor air temperature.

3.12.7. Occupied Mode:

The heating system is Occupied Mode as determined by the associated Time Schedule.

Boilers are modulated by the BAS to maintain Hot Water Supply Temperature Setpoint. Boilers are cycled on a call from supply water temperature in sequence to maintain the Hot Water Supply Temperature Setpoint.

The overall heating requirement signal is produced from the output of a heating PID loop %Htg to maintain the supply water temperature at setpoint.

For 2 Modulating Condensing Boilers, as the heating signal increases above the lead boiler start point (initially 30 % ON / 10 % OFF, all setpoints are adjustable), the lead boiler's circulation pump starts.

When this boiler circulation pump's status is verified on for 60 seconds, the lead boiler can start at its lowest output.

The lead boiler output is ramped up and down at 10 % per minute until it reaches 100 % output.

As the heating requirement increases above the lag boiler start point (initially 60 % ON / 50 % OFF), the lag boiler's circulation pump starts.

When this boiler circulation pump's status is verified on for 60 seconds, the lag boiler can start.

When the lag boiler starts, both boilers go to their minimum modulation outputs. They then modulate together, ramped at 10 % per minute from minimum to 100 % with the heating signal.

When the boilers have ramped down to their minimum modulation outputs based on the heating signal demand, and have been there for 60 seconds, the lag boiler is turned off.

The lag boiler circulation pump runs for 5 minutes or until the return and supply boiler water temperatures are within 1 °C of each other and then it shuts off.

The lead boiler then modulates alone (ramped) as required by the heating signal.

When the lead boiler is at minimum modulation output for 60 seconds it is turned off.

The lead boiler circulation pump runs for 5 minutes or until the return and supply boiler water temperatures are within 1 °C of each other and then it shuts off.

For 3 Modulating Condensing Boilers, as the heating signal increases above the lead boiler start point (initially 30 % ON / 10 % OFF, all setpoints are adjustable), the lead boiler's circulation pump starts.

When this boiler circulation pump's status is verified on for 60 seconds, the lead boiler can start at its lowest output.

The lead boiler output is ramped up and down at 10 % per minute until it reaches 100 % output.

As the heating requirement increases above the lag1 boiler start point (initially 60 % ON / 50 % OFF), the lag boiler's circulation pump starts.

When this boiler circulation pump's status is verified on for 60 seconds, the lag1 boiler can start.

When the lag1 boiler starts, both boilers go to their minimum modulation outputs. They then modulate together, ramped at 10 % per minute from minimum to 100 % with the heating signal.

As the heating requirement increases above the lag2 boiler start point (initially 90 % ON / 50 % OFF), the lag2 boiler's circulation pump starts.

When this boiler circulation pump's status is verified on for 60 seconds, the lag2 boiler can start.

When the lag2 boiler starts, the three boilers go to their minimum modulation outputs. They then modulate together, ramped at 10 % per minute from minimum to 100 % with the heating signal.

When the three boilers have ramped down to their minimum modulation outputs based on the heating signal demand, and have been there for 60 seconds, the lag2 boiler is turned off.

The lag2 boiler circulation pump runs for 5 minutes or until the return and supply boiler water temperatures are within 1 °C of each other and then it shuts off.

When the two boilers have ramped down to their minimum modulation outputs based on the heating signal demand, and have been there for 60 seconds, the lag1 boiler is turned off.

The lag1 boiler circulation pump runs for 5 minutes or until the return and supply boiler water temperatures are within 1 °C of each other and then it shuts off.

The lead boiler then modulates alone (ramped) as required by the heating signal.

When the lead boiler is at minimum modulation output for 60 seconds it is turned off.

The lead boiler circulation pump runs for 5 minutes or until the return and supply boiler water temperatures are within 1 °C of each other and then it shuts off.

3.12.8. Lead/Lag Boiler operation:

Provided for boilers on a weekly basis. Typically rotated on a Tuesday at 1:00 p.m. when a new lead boiler is assigned. The next lag boiler is to start should the Lead Boiler fail to start.

The boiler circulating pumps are hard wired by the Mechanical Contractor to the local boiler controls and flow switch(s) so that each boiler starts when the associated pump is confirmed running through the flow switch(s). The boiler circulating pump current draws are monitored by BAS to determine status.

3.12.9. **Main Heating Pumps:**

One of the main heating pumps will operate continuously when heat is enabled. They operate on a weekly lead/lag operation, typically rotated on a Thursday at 1:00 p.m. when a new lead pump is assigned. (Lag pump starts if lead pump fails or is in alarm mode)

Main heating pumps are monitored by BAS for status.

Main heating pumps are exercised to run for 10 minutes once a week, typically lead pump on a Thursday at 1:00 p.m. and lag pump at 1:30 p.m. when the system is off in summer mode.

3.12.10. **Main Pump Modulated Flow:**

The main heating pump speed (normally controlled by a VFD provided by others) is modulated to maintain the minimum differential pressures of the multiple sensors (where applicable) at the setpoint required for the individual heating loops.

3.12.11. **Limits and Safeties:**

3.12.11.1. The supply water temperature setpoint is limited to operate between 45 °C and 95 °C. (As per boiler specifications)

3.12.11.2. Summer mode delay shutdown. The primary heating pumps have a delay-off time of 5 minutes.

3.12.11.3. Minimum Boiler Runtime with Circulating Pump Interlock: Each boiler must run at least 2 minutes before it will modulate above the minimum firing rate. The boilers cannot modulate up from the minimum fire until the boiler circulating pump status is on.

3.12.11.4. Inter-boiler Runtime Delay: The lead boiler must run at least 5 minutes before the next boiler can start. The delay is increased to 30 minutes when switching from summer to winter operation.

3.12.12. **Alarms:**

3.12.12.1. Hot water supply temperature too high alarm (triggered above 12 °C deviation from setpoint after a 600 second time delay and restored below 10 °C deviation from setpoint).

3.12.12.2. Hot water supply temperature too low alarm (triggered below -12 °C deviation from setpoint after a 300 second time delay and restored above -10 °C deviation from setpoint). (Alarm is routed to Heat Loss Alarm for notification of security staff).

3.12.12.3. Boiler alarm in an incorrect state (separate alarm for each boiler).

3.12.12.4. Any pump in an incorrect state after a 300 second time delay (separate alarm for each pump).

3.12.12.5. Any VFD alarm (separate alarms for each VFD).

3.12.12.6. Differential water pressure too high alarm (triggered above 5 psi deviation from setpoint after a 600 second delay and restored below 3 psi deviation from setpoint) or too low alarm (triggered below -5 psi deviation from setpoint after a 300 second delay and restored above -3 psi deviation from setpoint) (separate alarm for each differential pressure sensor).

3.13. **Hydronic Heating Control Valves Sequence of Operations:**

When a hydronic hot water wall fin/convectors, radiant panels, or similar perimeter heat serves a room that is also served by an associated fan system/rooftop unit, the hot water perimeter heat is to be sequenced (where appropriate) as the first stage of heating for each applicable zone.

The space sensor PID controller modulates the perimeter heat control valve as a first stage of heating for each applicable zone to maintain setpoint.

3.13.1. **Hot Water Wall Fin / Convectors / Radiant Panels**

Non adjustable space temperature plate sensor or room temperature sensor with local setpoint adjust and pushbutton override is provided where indicated.

3.13.1.1. **Perimeter Convector Heaters**

Space sensor modulates the valve for heating to maintain room temperature setpoint, which is reduced during unoccupied hours.

Space sensor is used as low temperature alarm

3.13.1.2. **Cabinet Unit Heaters**

Space sensor cycles unit heater for heating to maintain setpoint.

Space sensor is used as low temperature alarm

3.13.1.3. **Limits and Safeties**

Hydronic heating control valves are to fail open to heat.

3.13.1.4. **Alarms**

An alarm is generated at the BAS when:

The space temperature is too low alarm (triggered below 14 °C and restored above 16 °C)

The space temperature is too high alarm (triggered above 38 °C and restored below 36 °C)

Low temperature alarm to be integrated through security to On-Call Response

3.14. **In-Floor Hydronic Slab Heating Sequence of Operations:**

The two-way in-floor heating valve(s) are cycled by the slab temperature sensor to maintain slab temperature setpoint which is reset from the outside air temperature and offset by the minimum room temperature reading of the associated zone heating wall temperature sensor(s) as follows:

The outside air temperature resets the slab temperature setpoint on a linear setting

<u>Outside Air Temperature</u>	<u>Slab Temp Setpoint resets to</u>
5 °C or lower	27 °C
16 °C or higher	22 °C

The minimum room temperature provides an offset to the slab temperature setpoint on a linear setting

<u>Minimum Room Temperature</u>	<u>Slab Temp Setpoint Offset</u>
18°C	0 °C
23°C	-2 °C

Limits and Safeties

In-floor slab hydronic heating is disabled when the Heating Enable Mode is disabled.

3.14.1. Alarms

An alarm is generated at the BAS when:

The space temperature is too low (triggered below 14 °C and restored above 16 °C). Low temperature alarm to be integrated through Security to On-Call Response

The space temperature is too high alarm (triggered above 38 °C and restored below 36 °C)

The slab temperature is too high alarm (triggered above 32 °C and restored below 30 °C)

3.15. **Chilled Water Cooling Coils Sequence of Operations: Unoccupied Mode**

The cooling coil valve is closed. There can be no unoccupied cooling.

3.15.1. Occupied Mode

The cooling coil valve modulates open when there is chilled water in the CW mains.

3.15.2. Limits and Safeties:

Cooling valves are closed when the outside air temperature is below the global cooling disable setpoint or the CW mains temperature is above 20°C.

3.16. **Cooling Tower with Heat Pump Loop - Sequence of Operations:**

3.16.1. Cooling Tower Disabled Mode

Cooling Tower Pump is disabled when the outdoor air temperature is below 5 °C.

3.16.2. Cooling Tower Enabled Mode

Cooling Tower Pump is enabled when the outdoor air temperature is above 6 °C.

Heat Pump Loop Supply Water Temperature Sensor controls two stages of cooling and modulates the heating valve in sequence to maintain the Heat Pump Loop Supply Water Temperature setpoint.

3.16.3. Heating Mode:

Heat Exchanger Circulating Pump turns on when Heat Pump Loop Supply Water Temperature drops below 17 °C and Heat Exchanger Valve modulates to maintain 17 °C Heat Pump Loop Supply Water Temperature.

3.16.4. Cooling Mode:

3.16.4.1. As the Heat Pump Loop Supply Water Temperature rises from 17 °C to 20 °C the Heat Exchanger Valve modulates closed to heating and the Heat Exchanger Circulating Pump stops.

3.16.4.2. As the Heat Pump Loop Supply Water Temperature rises from 22 °C to 23.5 °C Cooling Tower discharge damper opens and spray pump starts with 10 second delay ON.

3.16.4.3. As the Heat Pump Loop Supply Water Temperature rises from 26 °C to 28 °C Cooling Tower fan is enabled with 10 second delay ON. Actual start/stop of the Cooling Tower fan is controlled by the discharge damper controller.

3.16.5. Lead/Lag Control is provided for the two Heat Pump Loop Pumps on a weekly basis. If the flow switch indicates no flow, both Heat Pump Loop Pumps will run (resets every 4 hours).

3.16.6. Indication is provided for heat exchanger entering and leaving water temperature, Heat Pump Loop Return Water temperature and Cooling Tower leaving water temperature.

3.16.7. Cooling Tower pump(s) are exercised to run for 5 minutes once a week, typically lead pump on a Thursday at 1:00 p.m. and lag pump at 1:30 p.m. when the Cooling Tower is enabled. (Chemical tower basin chemical agitation)

3.16.8. Limits and Safeties

3.16.8.1. Each output has a time delay-on of 10 to 20 seconds to prevent all equipment from starting at once.

3.16.8.2. One loop pump is wired to fail on the 'on' position.

3.16.8.3. The cooling tower pump is disabled when the outdoor air temperature is disabled below 5 °C and enabled above 6 °C.

- 3.16.8.4. The cooling tower fan has a minimum off-time of 90 seconds.
- 3.16.8.5. The cooling tower fan cannot start unless the discharge damper end switch is closed.
- 3.16.8.6. If the Heat Pump Loop supply water temperature and Heat Pump Loop return water temperature are out of range (for 4 minutes), all heat pumps stop and an alarm is generated at the BAS.

3.16.9. Alarms

- 3.16.9.1. Any Heating Loop Pump in incorrect mode.
- 3.16.9.2. Any Cooling Loop Pump in incorrect mode.
- 3.16.9.3. Low boiler supply water temperature alarm (triggered below 20 °C and restored above 25 °C, disabled when boiler is shut off).
- 3.16.9.4. High boiler supply water temperature alarm (triggered above 95 °C and restored below 93 °C).
- 3.16.9.5. Low boiler return water temperature alarm (triggered below 20 °C and restored above 25 °C, disabled when boiler is shut off).
- 3.16.9.6. High boiler return water temperature alarm (triggered above 92 °C and restored below 90 °C).
- 3.16.9.7. Cooling tower fan in incorrect mode.
- 3.16.9.8. Low Heat Pump Loop return water temperature alarm (triggered below 15 °C and restored above 16 °C) or high Heat Pump Loop return water alarm (triggered above 34 °C and restored below 33 °C).
- 3.16.9.9. Low Heat Pump Loop supply water temperature alarm (triggered below 15 °C and restored above 16 °C) or high Heat Pump Loop supply water temperature alarm (triggered above 34 °C and restored below 33 °C).
- 3.16.9.10. No flow in loop.
- 3.16.9.11. Cooling tower damper in the wrong position.

3.17. Condenser Water Cooling Tower with Chiller System Sequence of Operations:

3.18. Cooling Tower Disabled Mode

Cooling Tower Pump is disabled when the outdoor air temperature is below 5 °C.

3.18.1. Cooling Tower Enabled Mode

Cooling Tower Pump is enabled when the outdoor air temperature is above 6 °C.

- 3.18.1.1. On a call for cooling, the following sequence occurs: the chilled water pump starts and 30 seconds later the condenser water pump starts and when the pump statuses are confirmed on, the chiller starts.
- 3.18.1.2. Condenser water temperature sensor (entering chiller) cycles the cooling tower fan to maintain setpoint. (typically 27 °C)
- 3.18.2. Condenser water pump is exercised to run for 5 minutes once a week, typically lead pump on a Thursday at 1:00 p.m. at 1:30 p.m. when the system is on in summer mode. (Chemical tower basin chemical agitation).

3.18.3. Limits and Safeties

- 3.18.3.1. Each output has a time delay-on of 10 to 20 seconds to prevent all equipment from starting at once.
- 3.18.3.2. One loop pump is wired to fail on the 'on' position.
- 3.18.3.3. The Chilled water system is disabled when the outdoor air temperature falls 2 °C below Global Mechanical Cooling Enable Setpoint.
- 3.18.3.4. If the chilled supply water temperature and return water temperature are out of range (for 4 minutes), an alarm is generated at the BAS

3.18.4. Alarms

- 3.18.4.1. Condenser water pump and/or cooling tower fan in incorrect mode.
- 3.18.4.2. Condenser entering temp. too low (-6/-6°C dev. from setpoint, 300s delay) or too high (6/5°C dev. from setpoint, 300s delay).
- 3.18.4.3. Chiller fault.

3.19. Chilled Water Cooling System Sequence of Operations:

3.20. Chiller Disabled Mode

Chiller is disabled when the outdoor air temperature is below 16 °C (adjustable).

3.21. Chiller Enabled Mode:

- 3.21.1. Interlock cooling enable mode with heating enable mode to ensure no simultaneous heating and cooling.
- 3.21.2. When the chiller is enabled, chilled water pumps run continuously. The lead chilled water pump speed is modulated to maintain the differential water pressure at setpoint. This setpoint is automatically adjusted during the day to maintain the control valve on the loop with the greatest demand at the near open to minimize pump energy. The chilled water supply sensor modulates the chiller to maintain the supply water temperature setpoint which is reset from the outdoor air temperature as follows:

<u>OAT</u>	<u>CWST</u>
20 °C	11 °C
30 °C	6 °C

3.21.3. Main Chilled Water Pumps:

One of the main chilled water pumps operates continuously when mechanical cooling is enabled. They operate on a weekly lead/lag operation, typically rotated on a Thursday at 1:00 p.m. when a new lead pump is assigned. (Lag pump starts if lead pump fails or is in alarm mode)

Main chilled water pumps are monitored by BAS for status.

Main chilled water pumps are exercised to run for 10 minutes once a week, typically lead pump on a Thursday at 1:00 p.m. and lag pump at 1:30 p.m. when the system is off in winter mode (for pump and valve exercising). Not applicable if systems are drained.

3.21.4. **Main Pump Modulated Flow:**

The main chilled water pump speed (normally controlled by a VFD provided by others) is modulated to maintain the minimum differential pressures of multiple sensors (where applicable) at the setpoint required for the individual chilled water loops.

3.22. **Limits and Safeties:**

- 3.22.1. The chillers are enabled when the outdoor air temperature is greater than 16 °C for 60 minutes.
- 3.22.2. The enable temperature is reset up to 20 °C as the outdoor relative humidity falls from 50 %RH to 30 %RH.
- 3.22.3. Between September 15 and May 15, the chiller enable temperature is 22 °C.
- 3.22.4. The pumps delay off 5 minutes after the chiller is shut off.

3.23. **Alarms:**

- 3.23.1. Chilled water supply temperature too high alarm (triggered above 13 °C and restored below 11 °C) or too low alarm (triggered below 4 °C and restored above 6 °C) when chillers have been enabled for at least 30 minutes.
- 3.23.2. Chiller Alarm
- 3.23.3. Any chilled water pump is in an incorrect state or VFD alarm.
- 3.23.4. Differential water pressure too high alarm (triggered above 5 psi above setpoint and restored 3 psi below setpoint) for 10 minutes.

3.24. **Chilled Water Cooling Coils Sequence of Operations:Unoccupied Mode**

The cooling coil valve is closed. There can be no unoccupied cooling.

3.24.1. **Occupied Mode**

The cooling coil valve modulates open when there is chilled water in the CW mains.

3.24.2. **Limits and Safeties:**

Cooling valves are closed when the outside air temperature is below the global cooling disable setpoint or the CW mains temperature is above 20°C.

3.24.3. **Alarms**

- 3.24.3.1. 1) Space temperature too high (triggered above 38 °C and restored below 36 °C) or too low (triggered below 14 °C and restored above 15 °C)

3.25. **Ductless Split - Cooling Only Unit Sequence of Operations:**

3.25.1. **Unoccupied Mode**

The system is off. If the pushbutton on the room sensor is pressed, the system will switch to the occupied mode for a period of 2 hours (adjustable).

3.25.2. **Occupied Mode**

The room temperature sensor cycles the ductless split to maintain the occupied cooling setpoint. Setpoint adjustment of +/-1 °C is provided. The unit is disabled when the outside air temperature is below the global mechanical cooling disable setpoint (initially disabled below 12 °C and enabled above 14 °C).

3.25.3. **Limits and Safeties:**

- 3.25.3.1. The cooling mode is disabled when heating mode is enabled and when the Outside Air Temperature is below the global mechanical cooling disable setpoint (initially disabled below 16 °C and enabled above 18 °C).
- 3.25.3.2. A minimum off-time of 5 minutes is provided.
- 3.25.3.3. Cooling setpoint is limited to a minimum of 23.5 °C.
- 3.25.4. **Alarms**
- 3.25.4.1. An alarm is generated at the BAS if the room temperature is too cold (triggered below 14 °C and restored above 15 °C) or too hot (triggered above 36 °C and restored below 35 °C).
- 3.25.4.2. The fan status does not match the start/stop point.
- 3.25.4.3. Weekly fan runtime limit exceeded.

3.26. **Ductless Split - Heat Pump Sequence of Operations:**

3.26.1. **Unoccupied Mode**

The system is off. If the pushbutton on the room sensor is pressed, the system will switch to the occupied mode for a period of 2 hours (adjustable).

3.26.2. Occupied Mode

The room temperature sensor cycles the ductless split heat pump to maintain the occupied cooling setpoint (typically 24.5 °C) or occupied heating setpoint (typically 21.5 °C). Where applicable, the heat pump is to be the first stage of heating. Setpoint adjustment of +/-1 °C is provided.

3.26.3. Limits and Safeties:

- 3.26.3.1. The cooling mode is disabled when heating mode is enabled and when the Outside Air Temperature is below the global mechanical cooling disable setpoint (initially disabled below 16 °C and enabled above 18 °C).
- 3.26.3.2. The heating mode is disabled when cooling mode is enabled and when the Outside Air Temperature is above the global heating disable setpoint (initially disabled above 14 °C and enabled below 12 °C).
- 3.26.3.3. A minimum off-time of 5 minutes is provided.
- 3.26.3.4. Heat pump is disabled if the condensate pump fails. Hard-wired into the condensate pump safeties switch.
- 3.26.3.5. Cooling setpoint is limited to a minimum of 23.5 °C.
- 3.26.3.6. Heating setpoint is limited to a maximum of 22 °C.
- 3.26.3.7. Heat Pump heat mode is disabled when Outside Air Temperature is below 5 °C.

3.26.4. Alarms

An alarm is generated at the BAS if:

- 3.26.4.1. The room temperature is too cold (triggered below 14 °C and restored above 15 °C) or too hot (triggered above 36 °C and restored below 35 °C).
- 3.26.4.2. The heat pump fan status does not match the start/stop point.
- 3.26.4.3. Weekly fan runtime limit exceeded.

3.27. Water to Air Heat Pump Unit Sequence of Operations:

3.27.1. Discretionary Fire Alarm Shutdown Mode:

The supply fan is off, heating is disabled and cooling is disabled. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal Heat Pump Unit functions are auto restored on relay signal from the fire alarm panel reset.

3.27.2. Software Freeze-stat Shutdown Mode:

The duct/unit mounted supply air temperature sensor acts as a software freeze-stat (triggered below 1 °C after 30 seconds, restored above 5 °C after 5 minutes, and auto reset after 5 minute delay).

3.27.3. Unoccupied Mode:

Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday. The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes. The system will cycle between Idle State, Heating State or Pushbutton Override States to meet the demands from each state and return to the Idle State when the demands are satisfied.

3.27.3.1. (Idle State)

The supply fan is off, heating is disabled and cooling is disabled.

3.27.3.2. (Unoccupied Heating State)

System cycles on a call for unoccupied heating. A full call for heating until setpoint is reached. Heating temperature nominally 16.0 °C space temperature setpoint with an increased space temperature setpoint to 17.0 °C at -10.0 °C OAT or lower and 18.0 °C at -20.0 °C OAT or lower (each adjustable)
Mechanical Cooling: Disabled

3.27.3.3. (Push Button Override State)

If the override pushbutton is pressed, at any room sensor, the associated system will switch to the Occupied Mode for 2 hours (adjustable). With outdoor air ventilation and cooling enabled.

3.27.4. Morning Warmup Mode:

An optimized start, based on the time of day schedule of the associated Make Up Air Unit, outdoor air temperature and the lowest indoor zone temperature is provided for heating.

The supply fan is on, heating is enabled at full capacity and the cooling is disabled.

The optimized start program is to begin up to 105 minutes before the occupancy schedule to allow for morning warm up to bring the lowest zone temperature up to occupancy setpoint.

3.27.5. Occupied Mode:

Time of day schedule, which starts the associated Make Up Air unit along with an Optimum Start program usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule, Standby Occupancy Mode or Unoccupied Mode.

Global Ventilation Schedule is enabled.

Heat Pump fan status confirmed by current sensing device(s).

Fan operation: The supply fan runs continuously.

Room heating temperature setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)

Room Free Cooling Enabled temperature setpoint nominal 22.5 °C +/-1.0 °C

Room mechanical cooling temperature setpoint nominal 24.5 °C +/- 1.0 °C (adjustable)

- 3.27.6. **Standby Occupancy Mode:**
Time of day schedule starts the HVAC unit(s) usually between 4:00 p.m. and 11:00 p.m. Monday to Friday.
Minimum outdoor air is set to zero when the global ventilation schedule is off).
Fan operation: Supply fan and return fan (where applicable) runs only on a call from heating or cooling only.
Ventilation normally set to zero (with a future provision to adjust).
Room heating temperature setpoint nominal: 21.5 °C +/- 1.0 °C (adjustable)
Room Mechanical Cooling temperature setpoint nominal 24.5 °C +/- 1.0 °C (adjustable)
Free Cooling: Disabled
Global Ventilation Schedule: Disabled
- 3.27.7. **Heating Sequence:**
- 3.27.7.1. **Outdoor Air Temperature used to determine Heating Enable Mode:**
A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the heating enable mode based on the outdoor air temperature below the threshold. The threshold is further adjusted by a calendar schedule.
Typical default values are: 16 °C from September to May and 5 °C from June to August.
- 3.27.7.2. **Default Setpoint:**
When the Heating Mode is active, the default room temperature setpoint remains unchanged.
- 3.27.7.3. **Call for Heating:**
Heat pump is used for heating until the heating calls (from room controller PID or Night Setback thresholds) are satisfied.
Radiation Zone
Where there is a zone served by radiation, the radiation valve opens (where applicable) and is to be the second stage of heat.
- 3.27.8. **Cooling Sequence:**
- 3.27.8.1. **Outdoor Air temperature used to determine cooling enable mode:**
A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the cooling enable mode based on the outdoor air temperature exceeding the threshold. The threshold is further adjusted by a calendar schedule. Typical default values are: 18 °C from September to May and 21 °C from June to August.
- 3.27.8.2. **Default Cooling Setpoint:**
When the cooling enable mode is active, the default room temperature setpoint is raised by 3°C.
- 3.27.8.3. **Call for Cooling:**
Mechanical cooling will be used until the cooling calls (from room controller PID) are satisfied.
- 3.27.9. **Limits and Safeties:**
- 3.27.9.1. The supply fan has a delay-off time of 90 seconds.
- 3.27.9.2. The heat pump cooling has a minimum-off time of 5 minutes.
- 3.27.9.3. Lock out operation of the heat pump if the associated water loop temperature is out of range.
- 3.27.10. **Alarms:**
An alarm will be generated upon the following conditions:
- 3.27.10.1. Fan status does not match the start/stop signal.
- 3.27.10.2. Space temperature too low alarm (triggered below 14 °C and restored above 16 °C).
- 3.27.10.3. Space temperature too high alarm (triggered above 38°C and restored above 36°C).
- 3.27.10.4. Supply air temperature too high alarm (triggered above 65 °C and restored below 63 °C) or too low alarm (triggered below 5 °C and restored above 7 °C).
- 3.27.10.5. Heat pump fault
- 3.27.10.6. Weekly fan runtime limit exceeded
- 3.27.10.7. Lock out operation of the heat pump if the associated water loop temperature is out of range. (triggered above 34 °C and restored below 33 °C, triggered below 15 °C and restored above 16 °C)
- 3.28. Electric Heat Sequence of Operation**
- 3.28.1. **Stairwells and Vestibules:**
- 3.28.1.1. **Heating Disabled:**
During Occupied Hours as set by the associated time schedule, heating is disabled when either the Outdoor Air Temperature above 12 °C or Vestibule Air Temperature above 18 °C are exceeded.
During Unoccupied Hours as set by the associated time schedule, heating is disabled when either the Outdoor Air Temperature is above 5 °C or Vestibule Air Temperature is above 17 °C are exceeded.
- 3.28.1.2. **Heating Enabled:**
During Occupied Hours as set by the associated time schedule, heating is enabled when both the Outdoor Air Temperature below 10 °C and Vestibule Air Temperature above 16 °C.

During Unoccupied Hours as set by the associated time schedule, heating is enabled when both the Outdoor Air Temperature below 0 °C and Vestibule Air Temperature below 16 °C.

3.28.1.3. Limits and Safeties:

- 1) Electric vestibule heaters are disabled when outside temperature threshold(s) are exceeded.
- 2) Electric vestibule heaters are disabled when room temperature threshold(s) are exceeded.

3.28.1.4. Alarms:

- 1) Electric vestibule temperature too low or too high.

3.28.2.

Utility Spaces:

3.28.2.1. Heating Disabled:

Heating is disabled when either the Outdoor Air Temperature above 12 °C or Vestibule Air Temperature above 18 °C are exceeded.

3.28.2.2. Heating Enabled:

Heating is enabled when both the Outdoor Air Temperature below 10 °C and Vestibule Air Temperature above 16 °C.

3.28.2.3. Limits and Safeties:

- 1) Electric heaters are disabled when outside temperature threshold(s) are exceeded.
- 2) Electric heaters are disabled when room temperature threshold(s) are exceeded.

3.28.2.4. Alarms:

- 1) Space temperature is too low or too high.

3.29. Fan Coil Units (Hydronic)

3.29.1. Unoccupied Mode

Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday.

The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes. The system will cycle between Idle State, Heating State or Pushbutton Override States to meet the demands from each state and return to the Idle State when the demands are satisfied.

3.29.2. (Idle State)

The supply fan is off, heating is off.

3.29.2.1. (Unoccupied Heating State)

3.29.2.2. System cycles on a call for unoccupied heating. A full call for (full heat modulation where applicable) heating until setpoint is reached.

3.29.2.3. (Push Button Override State)

The system is off. If the pushbutton (where applicable) on the room sensor is pressed, the system will switch to the occupied mode for a period of 2 hours (adjustable).

3.29.3. Occupied Mode

3.29.4. Heating Sequence:

3.29.4.1. Outdoor Air Temperature used to determine Heating Enable Mode:

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the heating enable mode based on the outdoor air temperature below the threshold. The threshold is further adjusted by a calendar schedule.

Typical default values are: 16 °C from September to May and 5 °C from June to August.

3.29.4.2. Default Setpoint:

When the Heating Mode is active, the default room temperature setpoint remains unchanged.

3.29.4.3. Call for Heating:

3.29.4.4. Heating or cooling mode is decided upon available water temperature.

3.29.4.5. Heating mode is when the water temperature is above the room temperature.

Mechanical heating is cycled on until the heating calls (from room controller PID or Night Setback thresholds) are satisfied.

3.29.5. Setpoint adjustment of +/- 1 °C is provided. (where applicable)

3.29.6. Cooling Sequence:

3.29.6.1. Outdoor Air Temperature used to determine Cooling Enable Mode:

A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the cooling enable mode based on the outdoor air temperature above the threshold. The threshold is further adjusted by a calendar schedule.

Typical default values are: 5 °C from September to May and 16 °C from June to August.

3.29.6.2. Default Setpoint:

When the Cooling Mode is active, the default room temperature setpoint remains unchanged.

3.29.6.3. Call for Cooling:

3.29.6.4. Cooling mode is decided upon available water temperature.

3.29.6.5. Cooling mode is when the water temperature is below the room temperature.

Mechanical cooling is used until the cooling calls (from room controller PID or Night Setback thresholds) are satisfied.

3.29.7. Setpoint adjustment of +/- 1 °C is provided. (where applicable)

- 3.29.8. Limits & Safeties
- 3.29.8.1. Heating is disabled when the outdoor air temperature is above the global heating disable setpoint (typically 2 °C above Heating Enable setpoint) or when the fan is off.
- 3.29.9. A minimum off-time of 5 minutes is provided.

- 3.29.10. Alarms
An alarm will be generated upon the following conditions:
- 3.29.10.1. Space temperature too high alarm (triggered above 42 °C and restored below 40 °C).
- 3.29.10.2. Space temperature too low alarm (triggered below 14 °C and restored above 16 °C).

3.30. Electric Force Flow Heater for Occupied Spaces Sequence of Operations:

- 3.30.1.1. Heating Disabled:
During Occupied Hours as set by the associated time schedule, heating is disabled when either the Outdoor Air Temperature above 12 °C or Space Air Temperature above 21 °C are exceeded.
During Unoccupied Hours as set by the associated time schedule, heating is disabled when either the Outdoor Air Temperature is above 5 °C or Space Air Temperature is above 19 °C are exceeded.
- 3.30.1.2. Heating Enabled:
During Occupied Hours as set by the associated time schedule, heating is enabled when both the Outdoor Air Temperature below 10 °C and Space Air Temperature above 21 °C.
During Unoccupied Hours as set by the associated time schedule, heating is enabled when both the Outdoor Air Temperature below 0 °C and Space Air Temperature below 19 °C.
- 3.30.1.3. Limits and Safeties:
1) Electric Space heaters are disabled when outside temperature threshold(s) are exceeded.
2) Electric Space heaters are disabled when room temperature threshold(s) are exceeded.
- 3.30.1.4. Alarms:
1) Electric Space temperature is too low or too high.

3.31. Exhaust Fan Sequence of Operations:

- General and Washroom Exhaust Fans
- 3.31.1. Discretionary Fire Alarm Shutdown Mode:
The Exhaust Fan is off. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code.
Normal Exhaust Fan functions are auto restored on relay signal from the fire alarm panel reset.
- 3.31.2. Unoccupied Mode:
Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday.
The system will be in Unoccupied Mode when not in Occupied by modes.
- 3.31.2.1. (Idle State)
The exhaust fan is off.position.
- 3.31.3. Occupied Mode:
Time of day schedule, which starts the Exhaust Fan unit(s) usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule or Unoccupied Mode.
Exhaust Fan status confirmed by current sensing device(s) or VFD feedback.
Fan operation: The Exhaust Fan runs continuously.
- 3.31.4. Limits and Safeties:
- 3.31.4.1. The Exhaust fan has a delay-off time of 90 seconds.
- 3.31.4.2. The start times are staggered across a group of Exhaust Fans.
- 3.31.5. Alarms:
An alarm will be generated upon the following conditions:
- 3.31.5.1. Fan status does not match the start/stop signal.
- 3.31.5.2. Weekly fan runtime limit exceeded.

3.32. Science Prep / Classroom Fume Hood Sequence of Operations:

- 3.32.1. Fume Hood in Use Mode:
The BAS provides AUTO/ENABLE with a manual operator's Start/Stop switch control of the fume hood exhaust fan according to a time schedule.
Fan status (where applicable) is monitored by a current sensor.
When the fan status is on, the return air dampers close to a position as determined by the air balancer (mechanical stop).
If the fume hood fan is running when the associated rooftop unit is off, the transfer damper (where applicable) opens to provide air from the room.

- 3.32.2. Limits and Safeties:
- 3.32.2.1. BAS system cycles the fan every 6 hours for 30 minutes (auto-flush).
Typically auto-flushes at 6:00 a.m. noon, 6:00 p.m. and midnight.
Alarms:
An alarm will be generated upon the following conditions:
- 3.32.2.2. Fan status does not match the start/stop signal.
- 3.32.2.3. Weekly fan runtime limit exceeded.

3.33. Kitchen Exhaust Hood Fan Sequence of Operations:

- 3.33.1. Occupied Mode:
The BAS provides AUTO/ENABLE with a manual operator's Start/Stop switch control of the Kitchen Exhaust hood fan according to a time schedule.
Fan status is monitored by a current sensor.
- 3.33.2. Unoccupied Mode:
Kitchen Exhaust Hood Fan is off.
- 3.33.3. Limits and Safeties:
- 3.33.3.1. When the fan hood is running and the DX cooling (where applicable) is on, the associated supply air system is locked off.
- 3.33.3.2. When the fan status is on, the return air dampers (where applicable) close to a position as determined by the air balancer (mechanical stop).
- 3.33.4. Alarms:
An alarm will be generated upon the following conditions:
- 3.33.4.1. Fan status does not match the start/stop signal.
- 3.33.4.2. Weekly fan runtime limit exceeded.

3.34. Make Up Air Unit Sequence of Operations:

- 3.34.1. Discretionary Fire Alarm Shutdown Mode:
The supply fan is off, the outdoor air dampers are in the 0% outdoor air position, heating is disabled and cooling (where applicable) is disabled. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal HVAC unit functions are auto restored on relay signal from the fire alarm panel reset.
- 3.34.2. Software Freeze-stat Shutdown Mode:
The duct/unit mounted supply air temperature sensor acts as a software freeze-stat (triggered below 1 °C after 3 minutes, restored above 5 °C after 3 minutes).
- 3.34.3. Unoccupied Mode:
Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday.
The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes. The system will cycle between Idle State, Heating State or Pushbutton Override States to meet the demands from each state and return to the Idle State when the demands are satisfied.
- 3.34.3.1. (Idle State)
The supply fan is off, the Global Ventilation Schedule is disabled, the outdoor air dampers are in the 0 % outdoor air position, heating is disabled and cooling (where applicable) is disabled.
- 3.34.3.2. (Unoccupied Heating State)
Applicable where reheat coils are used. Not applicable if fan-forced reheat coils are used.
System does not cycle on a call for unoccupied heating. A full call for (all stages or full heat modulation where applicable) heating until setpoint is reached.
Mechanical Cooling: Disabled
Free Cooling: Disabled
Global Ventilation Schedule: Disabled
- 3.34.3.3. (Push Button Override State)
Applicable where reheat coils are used. Not applicable if fan-forced reheat coils are used.
If the override pushbutton is pressed, at any room sensor, the associated system will switch to the Occupied Mode for 2 hours (adjustable). With outdoor air ventilation and cooling enabled.
- 3.34.4. Morning Warmup Mode:
Applicable where reheat coils are used. Not applicable if fan-forced reheat coils are used.
An optimized start, based on the time of day schedule, outdoor air temperature and the lowest indoor zone temperature is provided for heating.
The Global Ventilation Schedule is disabled. The supply fan is on, the exhaust fan is on (where applicable), the outdoor air dampers are in the 0 % outdoor air position, heating is enabled at full capacity and the cooling is disabled.
The optimized start program is to begin up to 105 minutes before the occupancy schedule to allow for morning warm up to bring the lowest zone temperature up to occupancy setpoint.

- 3.34.5. Occupied Mode:
Time of day schedule, which starts the Make Up Air Unit along with an Optimum Start program usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule, Standby Occupancy Mode or Unoccupied Mode.
Global Ventilation Schedule is enabled.
HVAC unit fan status confirmed by current sensing device(s) or VFD feedback.
Fan operation: The supply fan and exhaust fan (where applicable) run continuously.
Global Ventilation Schedule: Enabled
- 3.34.6. Standby Occupancy Mode:
Not applicable.
- 3.34.7. Ventilation Lockout (Sequence):
When the ventilation lockout switch, usually located in the Custodial Office, is engaged, Make Up Air Unit is disabled.
When the ventilation lockout switch is disengaged, systems return to mode of operation based on the time of day schedule.
- 3.34.8. Supply Air Temperature Setpoint:
The Supply Air Temperature Setpoint is reset between 13 °C to 18 °C as the outside air temperature falls from 10 °C to -15 °C.
The Supply Air Temperature Setpoint is limited to a range of 12 °C to 20 °C.
- 3.34.9. Heating Sequence:
- 3.34.9.1. Outdoor Air Temperature used to determine Heating Enable Mode:
A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the heating enable mode based on the outdoor air temperature below the threshold. The threshold is further adjusted by a calendar schedule.
Typical default values are: 16 °C from September to May and 5 °C from June to August.
- 3.34.9.2. Default Supply Air Temperature Setpoint:
Make Up Air Unit cooling is controlled from the supply air temperature sensor.
- 3.34.9.3. Call for Heating:
Mechanical (gas fired) heating is used until the heating calls (from supply air temperature controller PID or Night Setback thresholds) are satisfied.
Hydronic
For Heating Valve, (where applicable) 0 % signal (10 Volts) closes the heating valve. A 100% signal (below 2 Volts) opens the heating valve.
- 3.34.10. Cooling Sequence:
- 3.34.10.1. Outdoor Air temperature used to determine cooling enable mode:
A set of thresholds that are user adjustable at a global (board wide) or local (site specific) level, triggers the cooling enable mode based on the outdoor air temperature exceeding the threshold. The threshold is further adjusted by a calendar schedule. Typical default values are: 18 °C from September to May and 21 °C from June to August.
- 3.34.10.2. Default Supply Air Temperature Cooling Setpoint:
Make Up Air Unit cooling is controlled from the supply air temperature sensor.
- 3.34.10.3. Call for Cooling:
Mechanical cooling will be used until the cooling calls (from supply air temperature controller PID) are satisfied.
- 3.34.11. Limits and Safeties:
- 3.34.11.1. The duct mounted supply air temperature sensor acts as a high limit for each stage of heating (for stage 1: disable above 60°C , and enable below 50°C, for stage 2: disable above 55°C and enable below 45°C) and a low limit for each stage of cooling (for stage 1: disable DX1 below 5°C and enable DX1 above 10 °C, for stage 2: below 8 °C disable DX2 and above 13°C enable DX2).
- 3.34.11.2. The supply air temperature sensor acts as a software freezestat (triggered below 1 °C for 1 minute, restored above 5 °C for 1 minute).
- 3.34.11.3. The supply fan has a delay-off time of 90 seconds.
- 3.34.11.4. The DX cooling has a minimum-off time of 5 minutes.
- 3.34.11.5. DX cooling is disabled when the outdoor air temperature is below global DX disable setpoint (typically 2 °C below Cooling Enable setpoint) or when fan is off.
- 3.34.11.6. Gas heating is disabled when the outdoor air temperature is above the global heating disable setpoint (typically 2 °C above Heating Enable setpoint) or when the fan is off.
- 3.34.11.7. Stage 1 gas heating (where applicable for units with multiple stages of heating) has a minimum run time of 3 minutes.
- 3.34.11.8. When the ventilation lockout switch (usually located at the custodial office) is engaged, the Make Up Air Unit is disabled.
- 3.34.11.9. Cooling cannot turn on until heating has been off for a minimum of 5 minutes.
- 3.34.11.10. During Occupied Mode, and the outdoor air is above -1°C, heating stage 2 (where applicable) has a delay-on time of 15 minutes, except when the outdoor air temperature is below -3°C with a +2°C deadband.
- 3.34.12. Alarms:
An alarm will be generated upon the following conditions:
- 3.34.12.1. Fan status does not match the start/stop signal.
- 3.34.12.2. Supply air temperature too high alarm (triggered above 65 °C and restored below 63 °C) or too low alarm (triggered below 5 °C and restored above 7 °C).
- 3.34.12.3. Weekly fan runtime limit exceeded.

3.34.12.4. Software freezestat tripped.

3.35. Furnace Sequence of Operation:

Serving internal spaces like gym storage rooms. Uses return air only, no outside air ductwork. Supply air sensor to be used for indication. BAS enables the furnace through built-in Furnace controllers.

3.35.1. Discretionary Fire Alarm Shutdown Mode:

The furnace is disabled. This is not intended to replace the hard-wired fan shutdown provided by others when required by Code. Normal Furnace unit functions are auto restored on relay signal from the fire alarm panel reset.

3.35.2. Unoccupied Mode:

Mode is active usually between 11:00 p.m. to 7:00 a.m. Monday to Friday and 24 hours Saturday and Sunday.

The system will be in Unoccupied Mode when not in Morning Warmup, Occupied or Standby modes. The system will cycle between Idle State, Heating State or Pushbutton Override States to meet the demands from each state and return to the Idle State when the demands are satisfied.

3.35.2.1. (Idle State)

The furnace is disabled.

3.35.2.2. (Unoccupied Heating State)

System cycles on a call for unoccupied heating. A full call for (all stages or full heat modulation where applicable) heating until setpoint is reached.

Heating temperature nominally 16.0 °C space temperature setpoint with an increased space temperature setpoint to 17.0 °C at -10.0 °C OAT or lower and 18.0 °C at -20.0 °C OAT or lower (each adjustable)

3.35.3. (Push Button Override State)

If the override pushbutton (where applicable) is pressed, at any room sensor, the associated system will switch to the Occupied Mode for 2 hours (adjustable).

3.35.4. Occupied Mode:

Time of day schedule, which starts the HVAC unit(s) along with an Optimum Start program usually between 7:00 a.m. and 4:00 p.m. Monday to Friday, when not overridden by a Holiday Schedule, Standby Occupancy Mode or Unoccupied Mode.

Furnace unit fan status confirmed by current sensing device(s) or VFD feedback.

Fan operation: The supply fan runs continuously.

Room heating temperature setpoint nominal: 19 °C +/- 1.0 °C (adjustable)

3.35.5. Standby Occupancy Mode:

Time of day schedule starts the HVAC unit(s) usually between 4:00 p.m. and 11:00 p.m. Monday to Friday.

Furnace operation: Furnace runs only on a call from heating or cooling only.

Room heating temperature setpoint nominal: 18 °C +/- 1.0 °C (adjustable)

3.35.6. Heating Sequence:

3.35.6.1. Outdoor Air Temperature used to determine Heating Enable Mode:

If the outdoor air temperature is above Global Heating Enable Setpoint the unit is disabled.

3.35.6.2. Default Setpoint:

When the Heating Mode is active, the default room temperature setpoint remains unchanged.

3.35.6.3. Call for Heating:

Mechanical heating (single stage gas heating) is used until the heating calls (from room controller PID or Night Setback thresholds) are satisfied.

3.35.7. Limits and Safeties:

3.35.7.1. The supply fan has a delay-off time of 90 seconds.

3.35.7.2. Stage 1 gas heating (where applicable for units with multiple stages of heating) has a minimum run time of 3 minutes.

3.35.8. Alarms:

An alarm will be generated upon the following conditions:

3.35.8.1. Fan status does not match the start/stop signal.

3.35.8.2. Space temperature too high alarm (triggered above 42 °C and restored below 40 °C) for non-cooling systems, (triggered above 38°C and restored above 36°C) for cooling systems.

3.35.8.3. Space temperature too low alarm (triggered below 14 °C and restored above 16 °C).

3.35.8.4. Weekly fan runtime limit exceeded.

3.36. Destratification Fans Sequence of Operation: (Library/Gyms/Atrium)

Destratification Fans to be controlled by integral controls provided with fan packages (no BAS controls are anticipated).

3.37. Exterior Lighting Sequence of Operation:

3.37.1. Exterior Building Lights

The lights operate according to the time schedule. Lights are disabled between dawn and dusk, as calculated by a software astronomical timer. The following astronomical clock program for exterior lighting is in effect 7 days a week, at all schools, with the exception of schools with vandalism concerns.

September – June: On: 5:45 a.m. Off: At Dawn On: At Dusk Off: 11:45 p.m.

July and August: Exterior Lights Off

3.37.2. Parking Lot Lights

Where applicable, parking lot lighting should be zoned and scheduled separately from exterior building lighting. The lights operate according to the time schedule. Lights are disabled between sunrise and sunset, as calculated by a software astronomical timer.

The following astronomical clock program for exterior lighting is in effect 7 days a week, at all schools, with the exception of schools with vandalism concerns.

September – June: On: 6:00 a.m. Off: At Dawn On: At Dusk Off: 11:45 p.m.

July and August: Exterior Lights Off

3.37.3. Exterior School Sign

Controlled by integral controls provided with school sign packages (no BAS controls are anticipated)

3.38. Domestic Hot Water Recirc Pump (only enable/disable based on time of day schedule for secondary schools - elementary to use stand alone time/aquastat provided by others)

3.39. Low Temperature Alarm Sequence of Operation

3.39.1. Space Temperature

If any space temperature falls below 14 °C (adjustable), after 30 minutes, a local "heat loss" alarm will be activated through the security system.

System Integration

When adding new zones to an existing school, integration of the new zone's lowest space temperature is to be sent in from the new BAS system over to the existing BAS system via software or hardware point tied-in from the new BAS system to the existing BAS system. The original BAS system will have to have its software updated to accommodate the new heat loss point.

3.39.2. Hot Water Heating Supply Water Temperature

Applicable only when heating is enabled.

If the hot water heating supply water temperature is more than 15 °C (adjustable) below the setpoint or falls below 45 °C, a critical alarm will be activated through the security system. An alarm will also be generated at the BAS. The alarm will be disabled when outdoor air temperature is above heating enable setpoint.

3.40. Free Cooling Setpoint Sequence of Operation

The average outdoor air relative humidity is sent from the Vista Server to the Global Input for all schools where the Free Cooling Setpoint is calculated.

Free cool when $OAT < \text{minimum } (23\text{ }^{\circ}\text{C}, 29.4\text{ }^{\circ}\text{C} - \Phi/7.43)$ where Φ 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.

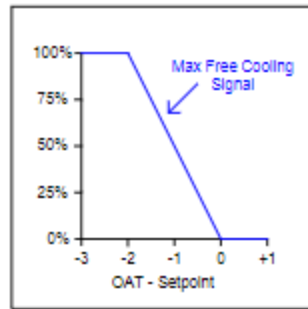
The free cooling signal decreases towards zero linearly as the outdoor air temperature increases from 2 °C less than the free cooling setpoint to 0 % at the setpoint.

This free cooling signal is used in each mixed air damper controller as the maximum the outdoor air dampers can open.

Minimum outdoor air damper position signal may exceed the free cooling signal.

The free cooling signal is still subject to the mixed damper safeties that would keep minimum position during occupied mode.

Also the free cooling signal will be at a lower priority than the CO₂ demand ventilation (where applicable) up to 40 % outside damper position.



Detail 1

3.41. **Miscellaneous Monitoring**

3.41.1. **Sump Pump Level Alarm (not by BAS)**

3.41.2. **VFD Drive Fault**

Provide a dry contact input to sense if VFD drive is in fault mode.
Produce an alarm at the BAS.

3.41.3. **Boiler Fault**

Provide a dry contact input to sense if Boiler is in fault mode.
Produce an alarm at the BAS.

3.41.4. **Chiller Fault**

Provide a dry contact input to sense if Chiller is in fault mode.
Produce an alarm at the BAS.

3.41.5. **Rooftop Unit Fault**

Provide a dry contact input to sense if the Rooftop Unit (where applicable) is in fault mode.
Produce an alarm at the BAS.

3.41.6. **Fire Alarm Active**

Provide a dry contact input to sense if Fire Alarm Active.
Produce an alarm at the BAS.

3.41.7. **Ventilation Lockout Button Active**

Provide a dry contact input to sense if the push button is active.
Indicate status on main graphic.

3.41.8. **Occupancy Sensor Active**

Provide a dry contact input to sense if Occupancy Sensor is Active.
Where applicable, read status of push button override on space sensor.

3.41.9. **Weekly Fan Runtime**

Provide a totalized point (measured in hours) of the fan status for use in trending and reports.
Reset to 0 hours each Monday at 00:00 hours.
Alarm at BAS when run time exceeds user adjustable threshold as shown on system graphic. (typically 60 hours)

3.42. **Energy Conservation Measures**

3.42.1. **Demand Limiting Control**

Energy conservation measures to strategically curtail the use of certain equipment (i.e. chillers, VFD drives) in order to not trigger excess electricity demands at peak load times.

3.42.2. **Orderly Shutdown**

Energy conservation measure to strategically curtail (reduce) the runtime of stages of heating and cooling by a variable amount of time before the end of occupancy.

3.42.3. **Weekly fan runtime monitoring**

A monitoring tool to track the amount of Fan Runtime on a weekly basis. A report quickly identifies the fans that ran an excessive amount of time.

3.42.4. **Trend generation**

Trends Logs are collected at the BAS server level for charting and exporting for analysis.

3.42.5. **Trend Archival operations**

Export logs and charts for future reference.

3.42.6. **Trend Data Analysis Support**

Trends Logs are collected at the BAS server level for charting and exporting for analysis.

- 3.42.7. Reporting Requirements
Keep consistent point naming conventions to allow for searches of logs and trends into reports across a system, site and multiple sites.

3.43. Setpoints and Schedule Standards

- 3.43.1. Default Occupied Room Heating Setpoint
Typically 21 °C.
- 3.43.2. Default Occupied Room Cooling Setpoint
Typically +3 °C above Default Occupied Room Heating Setpoint, limited to a minimum of 23.5 °C.
- 3.43.3. Default Standby Room Heating Setpoint
Typically 20 °C.
- 3.43.4. Default Standby Room Cooling Setpoint
Typically +3 °C above Default Occupied Room Heating Setpoint, limited to a minimum of 23.5 °C.
- 3.43.5. Default Unoccupied Room Heating Setpoint
Typically 19 °C.
- 3.43.6. Default Unoccupied Room Cooling Setpoint
Not used at WRDSB. (No mechanical cooling during unoccupied hours).
- 3.43.7. Default Gym Occupied Room Heating Setpoint
Typically 19 °C.
- 3.43.8. Default Occupied Schedule
Typically 7:00 a.m. to 4:00 p.m. Monday to Friday.
- 3.43.9. Default Standby Schedule
Typically 4:00 p.m. to 11:00 p.m.
- 3.43.10. Holiday Calendar Schedule
Board Holidays:
January 1st - New Year's Day
Family Day - Varies
March Break - Varies
July 1st - Canada Day
Labour Day - Varies
Thanksgiving - Varies
Winter Break - Varies
December 25 - Christmas Day
December 26 - Boxing Day

3.44. Alarm Handling

Alarms in Xenta are generated and pushed into the BAS.
Alarms in Distech can be programmed into the EC-BOS (JACE 8000) as a point extension and reported to the EC-BOS alarm console.

3.45. Outside Air Temperature

Located on the north face of the building.
Wired to a dedicated input, typically on a boiler controller (where applicable) or a master BAS controller and is shared across the BAS network to all the controllers in the building.
Used to reset setpoints and to enable/disable equipment for energy savings.

3.46. Outside Air Humidity

Located on the north face of the building.
Wired to a dedicated input, typically on a rooftop controller (where applicable) or a master BAS controller and is shared across the BAS network to all the controllers in the building.
Used to restrict free cooling if outdoor air conditions are not appropriate.

3.47. Carbon Dioxide

Located in the return air duct or room sensor.
Used to reset the minimum damper position.

3.48. Static Pressure

Located in the supply air duct referenced to a ceiling plenum (that has a constant neutral pressure) typically in VAV and VVT systems.
Used to control system pressure via the bypass damper for VVT or VFD fan speed in VAV systems.

3.49. **Graphics**

Systems are to be represented with line drawing graphics and not 3-dimensional graphics.
Line drawing graphics are more space efficient and load faster across networks.

3.49.1. **Navigation**

Central menu displaying all systems made available with hyperlinks.

3.49.2. **Structure**

Points folders are grouped under their physical controllers.

System folders containing the relevant points are grouped together.

3.49.3. **Symbols**

Two dimensional symbols and line based ductwork and piping diagrams.

3.49.4. **Colours**

Green text for user adjustable setpoints

Magenta text for calculated setpoints

Black text for sensors, statuses, inputs in general.

Red text for binary output commands in the Stop state.

Green text for binary output commands in the Start state.

Black text for analog control points like valves and dampers.

3.49.5. **Legend**

Indicate the meaning of the text colours.

3.49.6. **Floor Plan**

Scan from architectural drawings, simplify and format to convey the building envelope and room locations with current room names.

Zone temperatures with colour coded links to zones and systems from the graphic.

3.49.7. **Systems**

Two dimensional symbols and line based ductwork and piping diagrams.

Access to setpoints and schedules.

3.49.8. **Setpoint**

Green text for user adjustable setpoints

Magenta text for calculated setpoints

3.49.9. **Levels of Access**

Casual user: read only

Technical user: read/write access to setpoints and schedules, override access to points.

3.50. **Security**

3.50.1. **Levels of Access**

Casual user: read only

Technical user: read/write access to setpoints and schedules, override access to points.

External network access is not available. All network access is to be made on-site or from the Board Office.

4. **Appendix:**

4.1. **Appendix A: Humidity-Limited Free Cooling Table**

OAH		FreeClgSp		OAT		Difference		FreeClgMax	
85	%RH	17.96	°C	0	°C	-2	°C	100	%OA
99	%RH	16.08	°C	0	°C	-2	°C	100	%OA
45	%RH	23.34	°C	0	°C	-2	°C	100	%OA
60	%RH	21.32	°C	10	°C	-2	°C	100	%OA
70	%RH	19.98	°C	11	°C	-2	°C	100	%OA
80	%RH	18.63	°C	12	°C	-2	°C	100	%OA
60	%RH	21.32	°C	13	°C	-2	°C	100	%OA

OAH		FreeClgSp		OAT		Difference		FreeClgMax	
100	%RH	15.94	°C	13	°C	-2	°C	100	%OA
95	%RH	16.61	°C	14	°C	-2	°C	100	%OA
100	%RH	15.94	°C	14	°C	-1.94	°C	97.05	%OA
85	%RH	17.96	°C	15	°C	-2	°C	100	%OA
95	%RH	16.61	°C	15	°C	-1.61	°C	80.7	%OA
100	%RH	15.94	°C	15	°C	-0.94	°C	47.05	%OA
80	%RH	18.63	°C	16	°C	-2	°C	100	%OA
85	%RH	17.96	°C	16	°C	-1.96	°C	97.99	%OA
90	%RH	17.29	°C	16	°C	-1.29	°C	64.35	%OA
95	%RH	16.61	°C	16	°C	-0.61	°C	30.7	%OA
100	%RH	15.94	°C	16	°C	0	°C	0	%OA
70	%RH	19.98	°C	17	°C	-2	°C	100	%OA
80	%RH	18.63	°C	17	°C	-1.63	°C	81.64	%OA
90	%RH	17.29	°C	17	°C	-0.29	°C	14.35	%OA
70	%RH	19.98	°C	18	°C	-1.98	°C	98.94	%OA
80	%RH	18.63	°C	18	°C	-0.63	°C	31.64	%OA
90	%RH	17.29	°C	18	°C	0	°C	0	%OA
70	%RH	19.98	°C	19	°C	-0.98	°C	48.94	%OA
80	%RH	18.63	°C	19	°C	0	°C	0	%OA
90	%RH	17.29	°C	19	°C	0	°C	0	%OA
70	%RH	19.98	°C	20	°C	0	°C	0	%OA
80	%RH	18.63	°C	20	°C	0	°C	0	%OA
90	%RH	17.29	°C	20	°C	0	°C	0	%OA
70	%RH	19.98	°C	21	°C	0	°C	0	%OA
80	%RH	18.63	°C	21	°C	0	°C	0	%OA
90	%RH	17.29	°C	21	°C	0	°C	0	%OA
70	%RH	19.98	°C	22	°C	0	°C	0	%OA
80	%RH	18.63	°C	22	°C	0	°C	0	%OA
Inputs - Difference Limited to 0 and -2 °C				Outputs - Limited to 0 to 100 %OA					

OAH		FreeClgSp		OAT		Difference		FreeClgMax	
Inputs Difference= FreeClgSp-OAT (°C)		Outputs %Outside Air Damper Position (%OA)							
-2	°C	100	%OA						
0	°C	0	%OA						

4.2. Appendix B: Outside Air Temperature Limited Free Cooling Table

Outside Air Temperature (OAT)		Outside Air Temperature Limited (OAT Limited)		Final Damper Position High Limit (OatLL)	
-30	°C	-20	°C	0	%OA
-25	°C	-20	°C	0	%OA
-20	°C	-20	°C	0	%OA
-19	°C	-19	°C	3.33	%OA
-18	°C	-18	°C	6.67	%OA
-17	°C	-17	°C	10	%OA
-16	°C	-16	°C	13.33	%OA
-15	°C	-15	°C	16.67	%OA
-14	°C	-14	°C	20	%OA
-13	°C	-13	°C	23.33	%OA
-12	°C	-12	°C	26.67	%OA
-11	°C	-11	°C	30	%OA
-10	°C	-10	°C	33.33	%OA
-9	°C	-9	°C	36.67	%OA
-8	°C	-8	°C	40	%OA
-7	°C	-7	°C	43.33	%OA
-6	°C	-6	°C	46.67	%OA
-5	°C	-5	°C	50	%OA
-4	°C	-4	°C	53.33	%OA
-3	°C	-3	°C	56.67	%OA
-2	°C	-2	°C	60	%OA
-1	°C	-1	°C	63.33	%OA
0	°C	0	°C	66.67	%OA
1	°C	1	°C	70	%OA
2	°C	2	°C	73.33	%OA
3	°C	3	°C	76.67	%OA

Outside Air Temperature (OAT)		Outside Air Temperature Limited (OAT Limited)		Final Damper Position High Limit (OatLL)	
4	°C	4	°C	80	%OA
5	°C	5	°C	83.33	%OA
6	°C	6	°C	86.67	%OA
7	°C	7	°C	90	%OA
8	°C	8	°C	93.33	%OA
9	°C	9	°C	96.67	%OA
10	°C	10	°C	100	%OA
20	°C	10	°C	100	%OA
25	°C	10	°C	100	%OA
				Oat	OatLL
				-20	0
				10	100

4.3.



WRDSB BAS System Integration Specifications:

Note: Distech BAS SI Partners must incorporate the integration of the WRDSB NIAGARA BAS server as specified in this document. Upgrading or circumventing the functionality of the existing central WRDSB NIAGARA BAS server will not be considered. No unequivocal or irrevocable substitutions of the WRDSB BAS server allowed.

Distech SI Partners:

The fundamental purpose of BAS integration at the WRDSB consist of four primary objectives:

- 1) to maintain continuity of the Central Command Structure (a.k.a. Global/Local)
- 2) to allow for future expansion of centrally adjusted network variables/parameters
- 3) to maximize the administrative efficiency in which we can optimize the functionality and performance of the BAS systems inside 125+ buildings.
- 4) Maintain Web Security of entire BAS Infrastructure.

Central Command Structure: (two servers during transition period to Niagara-based software)

WRDSB Vista BAS Server

- 1) Update name to VISTA (formerly EC-TACBAS) on the WRDSB network.
- 2) is based on the Lonworks (LNS) Based Interface
- 3) utilizes Remote Network Interfaces (RNI) Ethernet adapters at each site to communicate to the Lonworks network at each site.
- 4) distributes all network variables via the RNI using the LNS protocol and Loytec NIC-IP to each site.
- 5) used to administer the TAC Xenta and Lonworks based BAS devices with the Echelon Lonmaker Network configuration tool, Schneider Electric TAC Vista System Plug-in Tool, and Schneider TAC Menta programming software.

WRDSB Niagara BAS Server

- 1) Update name to NIAGARA (formerly EC-TACBAS-T) on the WRDSB network
- 2) is based on the Niagara N4-based Distech EC-NET server software to administer the EC-BOS networking devices at each site
- 3) utilizes Niagara N4-based Distech EC-BOS networking servers complete with adapters at each site to communicate to the BACnet and Lonworks (where applicable) network at each site.
- 4) distributes all network variables via the Tridium Niagara FOX protocol to each site
- 5) used to administer the Distech BACnet and Lonworks (where applicable) based BAS devices with the Distech GFX programming/controller configuration and Tridium Niagara WorkBench software
- 6) utilizes Baudrate Schneider Electric TAC driver software (where applicable) to support the Lon-based TAC Xenta Controllers.



WRDSB BAS System Integration Specifications:

Network Variables: Over 30 network variables (as detailed in Appendix I) are distributed from the central WRDSB BAS server to all 125 sites at varying intervals:

- 1) for the purpose of zone temperature setpoint adjustment
- 2) to place lockouts on heating/cooling systems in response to changing seasonal conditions
- 3) to manage setpoints for night setback heating and cooling modes
- 4) to manage minimum outside air setpoints for ventilation requirements
- 5) to adjust the beginning and end of heating season
- 6) to manage boiler water temperature setpoint outdoor reset parameters
- 7) to set the morning warmup and night setback offset for boiler water temperature.
- 8) to place lockouts on ventilation based on building use requirements.
- 9) to place restrictions on ventilation based on humidity for additional energy savings measures.
- 10) to distribute humidity information from one of the three WRDSB humidity averaged zones
- 11) to distribute the central holiday schedule for setback mode operation
- 12) for Outdoor Lighting Astroclock Control adjustments to sundown and sunset times
- 13) for the purpose of after-hours alarms and troubleshooting
- 14) a dashboard is used at the central server to provide a user interface for all the variables and corresponding time/calendar schedules used in the BAS system.
- 15) a central alarm display is used to capture all incoming BAS alarms from each site.

To be provided by the Distech SI Partner:

A. Hardware Requirements:

- 1) **LON board inside Distech EC-BOS:** Installed on site, interfaces between site BAS system, Distech Lonworks Controller and Loytec NIC-IP.
- 2) **Loytec NIC-IP RNI:** Installed at each site, interfaces between site BAS system and WRDSB NIAGARA server via Ethernet and Lonworks networks.
- 3) **a LON-based Distech controller:** Must be current version. Installed on site, holds the network variables for use by both the WRDSB NIAGARA server and the site BAS system, and also the switching logic between local and global variable selection.
- 4) **Licensing for LON board, Baudrate Schneider TAC Xenta driver for the Distech EC-BOS:** Allows access to TAC Xenta controllers points, time schedules and alarms for use in the EC-BOS. Licensing confirmation of LON boards, Schneider TAC Xenta Driver, current Distech BAS SI Partner confirmation as a minimum.
- 5) **Distech BACnet MS/TP based controllers** are accepted for use with all the remaining systems.
- 6) **WRDSB Ethernet Drops:** Installed on site, to be co-ordinated with WRDSB IT department, fixed IP address to be assigned by IT.
- 7) **All existing functioning BAS devices** within each of the 125+ WRDSB buildings including but not limited to Lonworks, BACnet controllers as well as other field controls including sensors, valve or damper actuators, VFD drives, chiller systems, unit vents, air handlers, accessories or others, shall remain integrated. Approaches that require the replacement of existing functioning BAS



WRDSB BAS System Integration Specifications:

devices other than the required LAN interfaces for proper integration (EC-BOS / NIC-IP) will not be considered.

B. Software Requirements:

- 1) **Loytec Lconfig:** Used as setup tool to configure IP address on the Loytec NI-IP for use on WRDSB Ethernet network.
- 2) **Distech gfx:** Used as setup tool to program the Distech Lonworks controller to accept the network variables.
- 3) **Distech Workbench N4:** Used as a setup tool for the Distech EC-BOS

C. Turnover Requirements and Deliverables:

- 1) **Demonstrate:** full functionality of the integration from the WRDSB server altering the settings on each of the BAS controllers on site.
- 2) **Database files:** to be backed up and given to WRDSB facilities on USB drive.
 - a) **Loytec NIC-IP:** Configuration File
 - b) **Distech EC-BOS with Lonworks board and 5-year software updates license:** database file
 - c) **Distech Lonworks controller:** controller program file
 - d) **Menta:** controller program file for the existing TAC Xenta controllers (supplied by WRDSB to integrator)
- 3) **Security and Serviceability:**
 - a) Supply username and password.
 - b) Source programming software tools with never expiring licenses
 - c) Source files and databases for all BAS controllers, networking hardware to be able to network, initialize and replace BAS controllers.
 - d) Remote access to school BAS system will not be via VPN or similar method. It will be a managed firewall when available. WRDSB IT firewall and networking rules will need to be followed when integrating the BAS system to the WRDSB NIAGARA BAS Server.
- 4) **Reporting Requirements:**
 - a) **Network Transfer Diagram:** List in a matrix format, all Distech BAS controllers and associated the network variables, indicating the source and destination for each network variable.
 - b) **Version Control:** Maintain a variable for version number for each Distech BAS controller's software with a description of what changes and updates to the controller software were made, initialled, and dated by the programmer in the source code of the controller.
 - c) **Graphical User Interface:**



WRDSB BAS System Integration Specifications:

- i) **MAIN graphic:** Display all the global network variables, the adjustable local network variables, the adjustable local/global mode switch and the actual network variables in current use, which are actually sent to all the controllers on the local BAS network. Refer to attached sample graphic.
- ii) **SYSTEMS graphics (e.g., AC1, AHU1, RTU3):** Indicate the current status of the heating enable, cooling enable, adjustable Holiday Exemption flag, final zone setpoint, Minimum Outside Damper position, Maximum Outside Damper position, Minimum Outside Air Schedule status. Night setback heating and cooling setpoints.
- iii) **MAIN graphic:** A link to a notepad file application where an operator can maintain a running day and timestamp in logbook format for any changes/adjustments made to the system, noting any issues that may arise.

D. Implementation:

1. Chain of Data Custody Sequence:

- a) Network Variables/Parameters are written to the Distech Lonworks Controller by the WRDSB NIAGARA server via the Loytec NIC-IP adapter.
- b) The Distech EC-BOS reads the network variables and then stored on the Lon controller and then distributes them to each controller on the local BAS network for use in its sequence of operations.
- c) These network variables are to have a parallel set of local network variables stored in the Distech EC-BOS to be used in the local mode. The local mode when selected will transfer the use of the local network variables from the Distech EC-BOS to each controller on the local BAS network instead of the global network variables written to it by the WRDSB EC-TACBAS server.
- d) The local/global mode switch will be adjustable by the WRDSB NIAGARA server and shown on the main page graphic also adjustable by the operator.

2. Data Functionality and Persistence:

- a) All network variables/parameters must be backed up into non-volatile RAM so that the network variables are automatically restored after a reboot/cold start.
- b) Local/Global Mode Flag to be read/writeable from the WRDSB NIAGARA Server.
- c) Critical Alarms reported back to WRDSB NIAGARA server.
- d) If site is designated to have an outdoor humidity sensor, the real time value is to be sent back to the WRDSB EC-TACBAS server.

3. Overview

- a) Service office within 1 hour of all WRDSB Facilities during school hours and after hours.
- b) Written confirmation of Distech SI partnership for WRDSB territory.

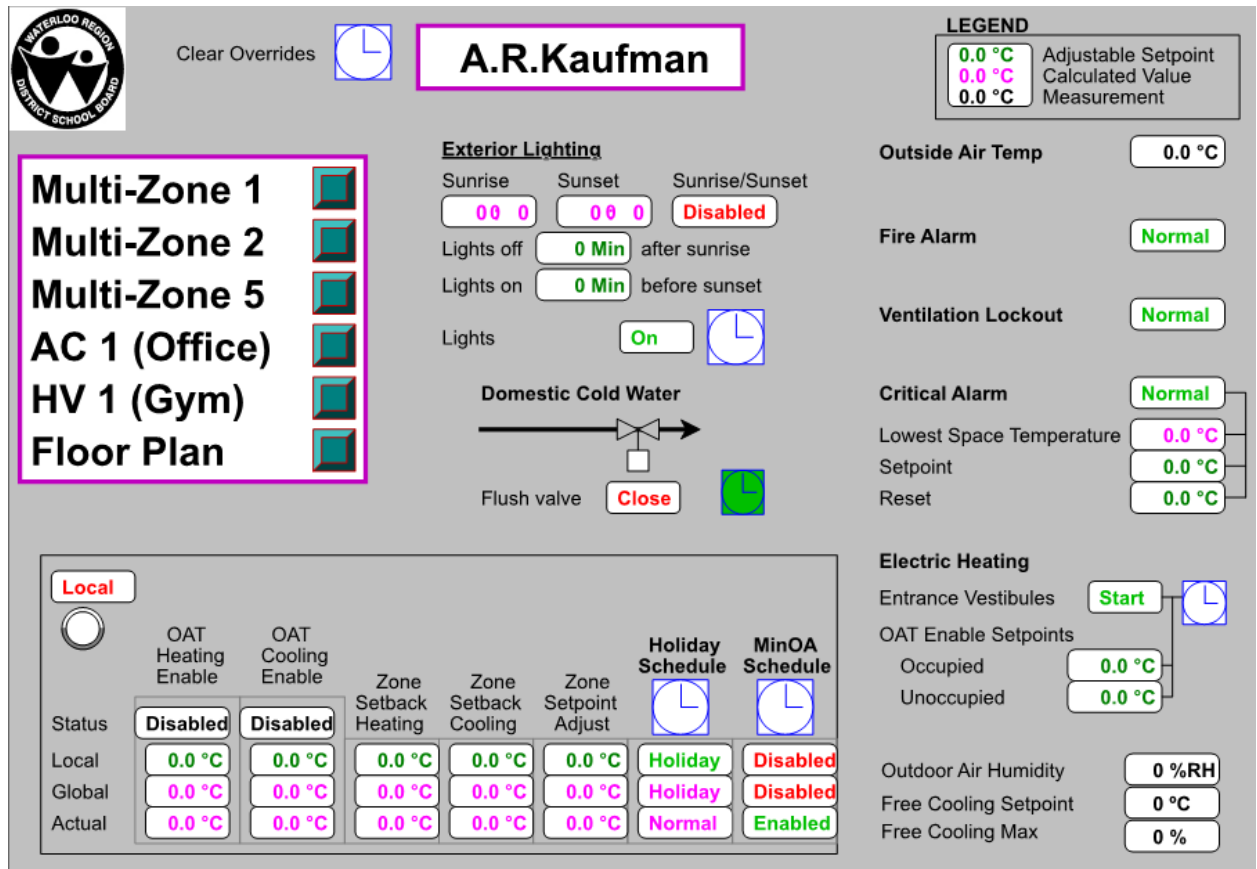


WRDSB BAS System Integration Specifications:

- c) Written confirmation of Schneider/TAC Xenta License for NIAGARA Server for WRDSB territory.

Sample I:

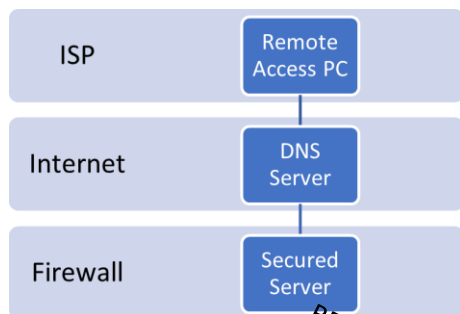
Typical **MAIN** graphic for each site representing the expected functionality and data representation of the local/global system:





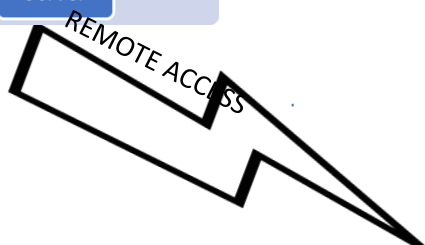
WRDSB BAS System Integration Specifications:

From Remote Access PC to WRDSB BAS Server to Site – General Architecture



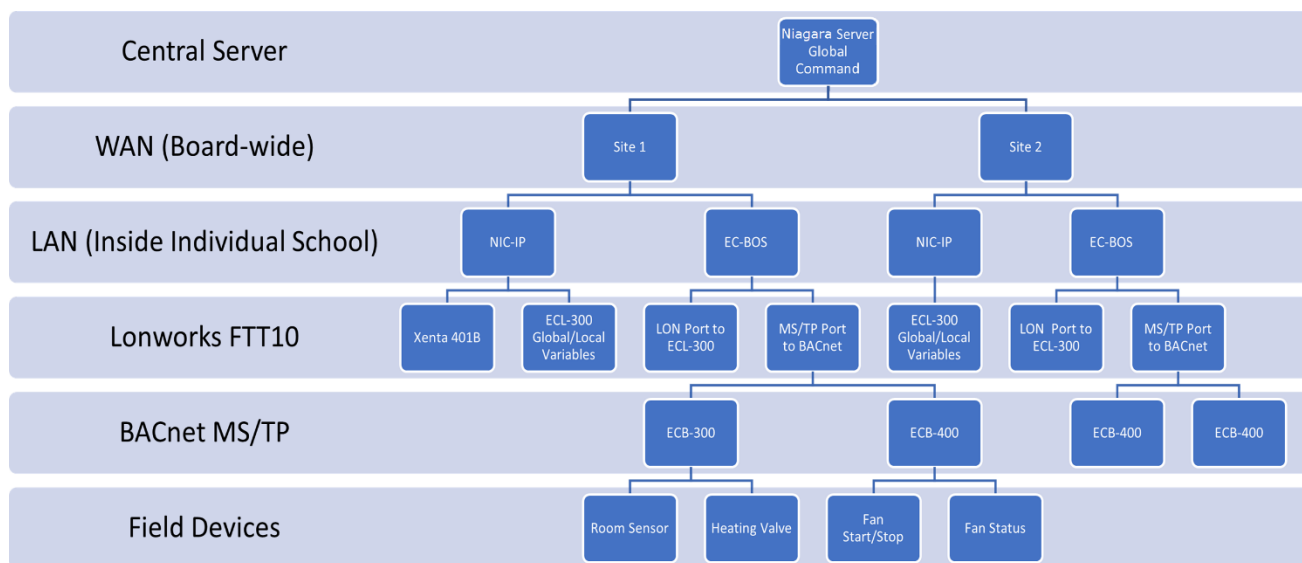
Notes:

- Remote Access Software could consist of Internet Browser, or BAS programming/configuration tools.
- Approved Vendor access
- WRDSB BAS
- WRDSB On-call



Firewall

- Network Variables originate from BAS Server.



- Network Variables are received at each site via the NIC-IP and onto the Distech ECL-300 or TAC Xenta 401B Controller and distributed for use at each BAS controller by the EC-BOS.



WRDSB BAS System Integration Specifications:

Appendix I - WRDSB BAS Network Variables:

Globally Distributed Variables from Central BAS Server to Each Site: Each controller on the BAS network on each site will use the following network variables/parameters to integrate into their sequence of operations.

For all Air Handling/Rooftop/Unit Vent Systems:

- 1) Heating Outside Air Temperature Enable**
- 2) Cooling Outside Air Temperature Enable**
- 3) Zone Temperature Night Setback Heating Temperature Setpoint**
- 4) Zone Temperature Night Setback Cooling Temperature Setpoint**
- 5) Zone Temperature Setpoint Adjust**
- 6) Holiday Scheduling**
- 7) Minimum Outside Air Enable Schedule (Zone 1)**
- 8) Minimum Outside Air Setpoint (Zone 1)**
- 9) Minimum Outside Air Setpoint (Zone 2)**
- 10) Minimum Outside Air Setpoint (Zone 3)**
- 11) Minimum Outside Air Setpoint (Zone 4)**
- 12) Outdoor Air Humidity (Zone 1 calculated average from 3 local sites)**
- 13) Outdoor Air Humidity (Zone 2 calculated average from 3 local sites)**
- 14) Outdoor Air Humidity (Zone 3 calculated average from 3 local sites)**
- 15) Outdoor Air Humidity Maximum Damper Position (Zone 1 Free Cooling Maximum)**
- 16) Outdoor Air Humidity Maximum Damper Position (Zone 2 Free Cooling Maximum)**



WRDSB BAS System Integration Specifications:

- 17) Outdoor Air Humidity Maximum Damper Position (Zone 3 Free Cooling Maximum)**
- 18) Outdoor Air Humidity Maximum Damper Position (Zone 4 Free Cooling Maximum)**
- 19) Free Cooling Maximum Mode (Zone 1)**
- 20) Free Cooling Maximum Mode (Zone 2)**
- 21) Free Cooling Maximum Mode (Zone 3)**
- 22) Free Cooling Maximum Mode (Zone 4)**

For Outdoor Lighting Astroclock Control:

- 1) Lights Off After Sunrise Offset (in minutes) Area 1**
- 2) Lights Off After Sunrise Offset (in minutes) Area 2**
- 3) Lights Off After Sunrise Offset (in minutes) Area 3**
- 4) Lights Off After Sunrise Offset (in minutes) Area 4**
- 5) Lights On Before Sunset (in minutes) Area 1**
- 6) Lights On Before Sunset (in minutes) Area 2**
- 7) Lights On Before Sunset (in minutes) Area 3**
- 8) Lights On Before Sunset (in minutes) Area 4**

For Boiler Systems: The 4 hot water setpoint outdoor temperature reset parameters: (sourced from 1 of 4 WRDSB location zones)

Boiler Systems Area 1:

- 1) Outside Air Temperature 1 2) Hot Water Temperature High Setpoint**
- 3) Outside Air Temperature 2 4) Hot Water Temperature Low Setpoint**
- 6) Morning Warmup Hot Water Temperature Offset**
- 7) Night Setback Hot Water Temperature Offset**



WRDSB BAS System Integration Specifications:

Gas and Boiler Systems Heating Enable/Disable Dates: (4 variables)

8)	Heating On Month	9)	Heating On Day
10)	Heating Off Month	11)	Heating Off Day

Boiler Systems Area 2:

1) Outside Air Temperature 1	2) Hot Water Temperature High Setpoint
3) Outside Air Temperature 2	4) Hot Water Temperature Low Setpoint
- 6) Morning Warmup Hot Water Temperature Offset**
- 7) Night Setback Hot Water Temperature Offset**

Gas and Boiler Systems Heating Enable/Disable Dates: (4 variables)

8)	Heating On Month	9)	Heating On Day
10)	Heating Off Month	11)	Heating Off Day

Boiler Systems Area 3:

1) Outside Air Temperature 1	2) Hot Water Temperature High Setpoint
3) Outside Air Temperature 2	4) Hot Water Temperature Low Setpoint
- 6) Morning Warmup Hot Water Temperature Offset**
- 7) Night Setback Hot Water Temperature Offset**

Gas and Boiler Heating Enable/Disable Dates: (4 variables)

8)	Heating On Month	9)	Heating On Day
10)	Heating Off Month	11)	Heating Off Day

Boiler Systems Area 4:

1) Outside Air Temperature 1	2) Hot Water Temperature High Setpoint
3) Outside Air Temperature 2	4) Hot Water Temperature Low Setpoint



WRDSB BAS System Integration Specifications:

6) Morning Warmup Hot Water Temperature Offset

7) Night Setback Hot Water Temperature Offset

Gas and Boiler Heating Enable/Disable Dates: (4 variables)

8)	Heating On Month	9)	Heating On Day
10)	Heating Off Month	11)	Heating Off Day

Additional Parameters used to calculate final values for distribution from Central Server:

- 1) Winter Outside Air Temperature Heating Enable Setpoint
- 2) Summer Outside Air Temperature Heating Enable Setpoint
- 3) Summer Winter Heating Schedule
- 4) Winter Outside Air Temperature Cooling Enable Setpoint
- 5) Summer Outside Air Temperature Cooling Enable Setpoint
- 6) Summer Winter Cooling Enable Schedule
- 7) Normal Night Setback Temperature Heating Enable Setpoint
- 8) Economy Night Setback Temperature Heating Enable Setpoint Calculated
- 9) Comfort/Economy Night Setback Heating Schedule
- 10) Outside Air Low Reset for Economy Night Setback Reset Heating Setpoint
- 11) Night Setback Low for Economy Night Setback Reset Heating Setpoint
- 12) Outdoor Air High Reset for Economy Night Setback Reset Heating Setpoint
- 13) Night Setback High for Economy Night Setback Reset Heating Setpoint
- 14) Normal Night Setback Temperature Cooling Enable Setpoint
- 15) Economy Night Setback Temperature Cooling Enable Setpoint Calculated
- 16) Comfort/Economy Night Setback Cooling Schedule
- 17) Normal Setpoint Adjust
- 18) Economy mode Setpoint Adjust
- 19) Comfort Economy Setpoint Adjust Schedule
- 20) Minimum Outside Air Damper Position Setpoint Schedule to Send Area 1
- 21) Minimum Outside Air Damper Position Setpoint Schedule to Send Area 2
- 22) Minimum Outside Air Damper Position Setpoint Schedule to Send Area 3
- 23) Minimum Outside Air Damper Position Setpoint Schedule to Send Area 4
- 24) Astroclock Lights Off After Sunrise /On Before Sunset Send Schedule Area 1
- 25) Astroclock Lights Off After Sunrise /On Before Sunset Send Schedule Area 2
- 26) Astroclock Lights Off After Sunrise /On Before Sunset Send Schedule Area 3
- 27) Astroclock Lights Off After Sunrise /On Before Sunset Send Schedule Area 4
- 28) Heating Systems Send Schedule Area 1



WRDSB BAS System Integration Specifications:

- 29) Heating Systems Send Schedule Area 2**
- 30) Heating Systems Send Schedule Area 3**
- 31) Heating Systems Send Schedule Area 4**

Locally Distributed Network Variables Distributed between Master controller and each Controller

within each site These Network Variables are centrally managed and distributed to each controller. A local copy of these variables are maintained and are adjustable when the site is set to local mode operation.

- 1) Outside Air Temperature**
- 2) Local Holiday Schedule**
- 3) Fire Alarm Status**
- 4) Ventilation Lockout Status**
- 5) Heating Outside Air Temperature Enable/Disable**
- 6) Cooling Outside Air Temperature Enable/Disable**
- 7) Zone Temperature Night Setback Heating Temperature Setpoint**
- 8) Zone Temperature Night Setback Cooling Temperature Setpoint**
- 9) Zone Temperature Setpoint Adjust**
- 10) Holiday Scheduling**
- 11) Minimum Outside Air Enable Schedule**

Additional calculated parameters used in the sequence of operations and shared across the site network:



WRDSB BAS System Integration Specifications:

1) Minimum Zone Temperature per Controller

2) Maximum Zone Temperature per Controller

3) Minimum Zone Temperature per Site (data is aggregated across all the controllers and concentrated at the single master controller that triggers the low temperature alarm contacts)

4) Maximum Zone Temperature per Site (data is aggregated across all the controllers and concentrated at the single master controller)

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 Examination

- .1 Preparation and Scheduling

- .1 Provide 4 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.

3.02 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.

3.03 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.

3.04 System Startup

- .1 At conclusion of installation, use appropriate arc flash protection during re-energizing of the equipment.

3.05 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 Section Includes

- .1 Common requirements for electrical work.
- .2 Mounting heights for electrical equipment and devices.

1.02 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.
- .7 All sections related to heat tracing.
- .8 Building Automation System integration requirements for Electrical Systems as described in Section 25 96 00.
- .9 This section is to be read in conjunction with Division 00 documents, and Division 01 specification sections, which take precedence as described in CCDC 2-2020.
 - .1 General Conditions.
 - .2 Supplementary General Conditions.
 - .3 General Requirements.

1.03 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.
- .3 Discipline and Trade Jurisdiction:
 - .1 In accordance with CCDC 2-2020 GC 1.1.9: Neither the organization of the Specifications nor the arrangement of Drawings shall control the Contractor in dividing the work among Subcontractors and Suppliers.
 - .2 MasterFormat's organizational structure used in a project manual does not imply how the work is assigned to various design disciplines, trades, or subcontractors. MasterFormat is not intended to determine which particular elements of the project manual are prepared by a particular discipline. Similarly, it is not intended to determine what particular work required by the project manual is the responsibility of a particular trade. A particular discipline or trade is likely to be responsible for subjects from multiple Divisions, as well as from multiple Subgroups.

1.04 Specifications Language and Style

- .1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to Contractor, unless stated otherwise.
- .2 Complete sentences by reading "shall", "Contractor shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.
- .3 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.
- .4 When used in the context of a Product, read the word "provide" to mean "supply and install to result in a complete installation ready for its intended use."

1.05 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 Consultant in writing before submitting Bid. 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. 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.
- .5 Determine final locations of major work within ceiling spaces based on the largest equipment first.
- .6 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 the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.
- .7 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.
- .8 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.
- .9 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.
- .10 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.

- .11 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.
- .12 Control devices, equipment requiring maintenance, junction boxes, 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.
- .13 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were foreseeable by a review of existing conditions or a review of drawings prepared by other disciplines.
- .14 Where drawings indicate that acoustic tile ceiling is being suspended below existing plaster ceilings, coordinate the design of framework used to support this suspended ceiling, lighting, diffusers, and other components that are mounted within or through ceiling. Do not mount devices to suspended ceilings. Secure and mount to ceiling slab above. Seal ceiling openings to maintain required fire rating.
- .15 Provide any fitting, offset, transformation, etc., required to suit architectural and structural details but not shown.

1.06 Work Restrictions

- .1 Refer to Division 01.
- .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.

1.07 Substitution Procedures

- .1 Refer to Division 01 and General Provisions of the Contract.
- .2 Additionally, "Approved equal" shall be defined as a substitution approved by the Consultant.
- .3 If during the tender bid process, the bidding contractor wishes to substitute the specified equipment for an "Approved equal", the bidding contractor must submit shop drawings to the Consultant before the tender close for approval. If no substitution request is made, the as-specified equipment is that to be provided.
- .4 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.
- .5 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.
- .6 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 manufacturer at time of shop drawing submittal.
- .7 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to the 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 the 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. The 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 the Consultant.

1.08 Contract Modification Procedures

- .1 Refer to Division 01.
- .2 Whenever the 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 the Consultant for review, a quotation being proposed cost for executing change or revision.

- .3 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.
- .4 Unless otherwise specified in Division 00, Division 01, or as identified in the Owner/Contractor agreement, allowable maximum percentages for overhead and profit are to be 7% and 5% respectively.
- .5 Unless otherwise specified in Division 00, or Division 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 Electrical material labour unit costs are to be in accordance with National Electrical Contractors Association (NECA) Manual of Labor Units (MLU), less 25%.
 - .3 Costs for journeyperson and apprentice labour must not exceed prevailing rates at time of execution of Contract and must reflect actual personnel performing work.
 - .4 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.
 - .5 Overhead percentage will be deemed to cover quotation costs other than actual site labour and materials, and rentals.
 - .6 Quotations, including those for deleted work, to include a figure for any required change to Contract time.
- .6 The Consultant reserves the right to request backup quotations for any materials and/or rentals included within the quotation.
- .7 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.
- .8 Make requests for changes or revisions to work to Consultant in writing and, if Consultant agrees, will issue Notice of Change.
- .9 Do not execute any change or revision until written authorization for the change or revision has been obtained from the Consultant.

1.09 Coordination

- .1 Refer to Division 01.
- .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, inserts, 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.

1.10 Submittal Procedures

- .1 Refer to Division 01.
- .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.
- .7 Confirm layouts of major electrical equipment rooms with the dimensions of as-procured equipment, and submit a layout sketch to the Consultant showing the major equipment and required clear spaces. The contractor may, at their option, revise the layout of the major electrical equipment rooms, but take responsibility for these new layouts and meeting the requirements of the local electrical utilities. Capture final room layouts on as-built drawings.

1.11 Safety Requirements

- .1 Refer to Division 01.
- .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.

1.12 Regulatory Requirements

- .1 Refer to Division 01.
- .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.

1.13 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th 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 (29th edition/2024), 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 100-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

- .6 2024 Ontario Building Code
- .7 CAN/ULC-S1001-11, Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.14 Definitions

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE 100.

1.15 Quality Assurance

- .1 Refer to Division 01.
- .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.

1.16 Quality Control

- .1 Refer to Division 01.
- .2 Provide a full time Superintendent to oversee and coordinate all sub-trades in these divisions.

1.17 Temporary Utilities

- .1 Refer to Division 01.
- .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.

1.18 Temporary Facilities and Controls

- .1 Refer to Section Division 01.
- .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 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.

1.19 Product Requirements

- .1 Refer to Division 01.
- .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 manufacturers. Identical units of equipment shall be of same manufacturer. In any unit of equipment, identical component parts shall be of same manufacturer, but the various component parts comprising the unit need not be of one manufacturer.
- .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 in the specifications are used in lieu of products of the manufacturer noted as "basis of design", 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 the Contractor.
- .17 In addition to the manufacturers specified or named as acceptable, the Contractor may propose substitute manufacturers of equipment and/or apparatus to the Consultant for acceptance, listing in each case a corresponding credit for each substitute 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 substitute 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 substitutions, will be borne by the party making the proposal. Substitute 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.

1.20 Examination and Preparation

- .1 Refer to Division 01.
- .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.

1.21 Cutting and Patching

- .1 Refer to Division 01.
- .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 the 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.

1.22 Cleaning and Waste Management

- .1 Refer to Division 01.
- .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.

1.23 Starting and Adjusting

- .1 Refer to Section Division 01.
- .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.

1.24 Closeout Procedures

- .1 Refer to Division 01.
- .2 The Consultant will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.
- .3 Building Permit Compliance
 - .1 Provide a minimum of 10 business days notice to the Consultant for scheduling of Consultant's occupancy inspection.
 - .2 Prior to requesting the Consultant's letter "Review of General Conformance" for submission to the municipal building department to allow occupancy, the following items must be complete and submitted to the Consultant, as applicable:
 - .1 General
 - .1 Submit all applicable inspection reports from Authorities Having Jurisdiction.
 - .2 Continuity of fire separations at service penetrations must be complete.
 - .3 All seismic restraint requirements as described in Section 26 05 48.16 must be complete.
 - .2 Electrical
 - .1 Provide Certificate of Acceptance from Electrical Inspection Department.
 - .2 Any devices not installed must have the wiring made safe and terminated in an outlet box complete with cover.
 - .3 All outlets must have cover plates installed. All electrical equipment not located in service rooms must have covers and/or doors installed complete.

- .4 Emergency lighting system must be operational and tested by the Contractor. Where battery units and remote heads are indicated on the drawing, provide certification letter from equipment manufacturer indicating the system meets code requirements.
- .5 Simulate normal power failure within the premises in the presence of the consultant and the owner's representative. Test and verify exit lights and emergency lighting operations under emergency conditions. Submit letter of certification copy to the Consultant stating that the systems have been tested, witnessed by the Consultant or the Owner's representative, etc., and the methods of installation and performance are satisfactory to all parties.
- .6 All exit lights must be installed and operational.
- .3 Electronic Safety and Security
 - .1 Fire alarm system and devices must be operational. Submit fire alarm verification report per CAN/ULC-S537, and submit audibility test. Indicate tap settings of all signalling devices.
 - .2 [CAN/ULC-S561 Fire Protective Signaling Certificate.
 - .3 Functional testing of the fire alarm system and interconnected systems per CAN/ULC-S1001 must be completed.
- .3 If any of the above items have not been completed at the time of Consultant's Inspection, and the letter of "assurance of professional field review and compliance" cannot be issued, any costs for subsequent Inspections will be charged to the Contractor.

1.25 Closeout Submittals

- .1 Refer to Division 01.
- .2 Project Record Documents
 - .1 Provide extra sets of white prints on which to make, as the job progresses, all approved changes and deviations from the original drawings. Complete as-built drawings accurately marked up in red ink must be submitted for review by the Consultant 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 As-Built AutoCAD drawings
 - .1 Request CAD release form from the Consultant, and submit completed form back to the Consultant.

- .2 Transfer the information from the "as-built" white prints to the files, and submit to the Consultant for review.
- .3 Employ a competent computer draftsman to indicate changes on the electronic set of as-built drawings. Provide drawings in PDF and AutoCAD formats.
- .4 Submit three (3) USB flash drives including as-built drawings in AutoCAD format, one with each O&M manual.
- .5 Provide three (3) sets of full size as-built drawings in hard copy format, one with each O&M manual.
- .6 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 one year from the date of acceptance. 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 Flashing and Sheet Metal

- .1 Refer to Division 07.
- .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.

3.03 Firestopping

- .1 Provide firestopping in accordance with Division 07 and Section 26 05 44.13.
- .2 Ensure that fire ratings of floors and walls are maintained.
- .3 Provide ULC classified firestopping products by 3M, Hilti, STI, or approved equal which have been tested in accordance with CAN/ULC-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.

3.04 Access Doors

- .1 Provide access doors in accordance with Division 08.
- .2 Before commencing installation of 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 the work to suit.

- .3 Group conduit work to ensure the minimum number of access doors is required.
- .4 Access doors are to be installed by the trade responsible for the particular type of construction in which the doors are required.

3.05 Painting and Finishes

- .1 Refer to Division 09.
- .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.

3.06 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.

3.07 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.
 - .5 For electric ranges: 130 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 ft).
 - .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.

3.08 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.

3.09 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 from any physical defects.
- .4 Provide labour and material to conduct the integrated systems testing of interconnected life safety systems in accordance with CAN/ULC-S1001-11, and provide written report for Consultant's review. Ensure all required trade contractors are present on site as directed by the Integrated Testing Coordinator during the CAN/ULC-S1001 functional testing. Refer to Section 01°91°26.13.

3.10 Closeout Activities

- .1 Refer to Division 01.
- .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 Division 02 – Existing Conditions.

1.03 Scheduling

- .1 Refer to Division 01.
- .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 visual field observations and conditions derived from existing drawings, and do not assess the interiors of electrical equipment. 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).
- .4 Existing feeders to remain.
 - .1 Where the drawings call for the re-use of existing feeders and re-connection to new equipment, (such as when equipment is replaced like-for-like), confirm the size and quantity of conductors of the existing feeder, and provide lug kits on new equipment suitable for the existing feeder.

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 Division 02, 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 12-25-5, or latest revision.
- .6 Provide knockout fillers when removing circuits from any panelboard or splitter.
- .7 Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- .8 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.

- .9 Disconnect and remove abandoned panelboards and distribution equipment.
- .10 Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- .11 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- .12 Repair adjacent construction and finishes damaged during demolition and extension work.
- .13 Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.
- .14 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 Fire resistive cables.
 - .4 Wiring connectors and connections.
- .2 Permitted voltage drop for feeder and branch circuits.

1.02 References

- .1 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 0.3:09 (R2023), Test methods for electrical wires and cables.
 - .4 CSA C22.2 No. 48:15 (R2020), Nonmetallic sheathed cable.
 - .5 CSA C22.2 No. 51:20, Armoured cables.
 - .6 CSA C22.2 No. 52:17 (R2022), Underground secondary and service-entrance cables.
 - .7 CSA C22.2 No. 65:18 (R2022), Wire connectors.
 - .8 CSA C22.2 No. 75:17 (R2022), Thermoplastic insulated wires and cables.
 - .9 CSA C22.2 No. 123:16 (R2021), Aluminum sheathed cables.
 - .10 CSA C22.2 No. 131:17 (R2022)14, Type TECK 90 cable.
- .2 NECA (National Electrical Contractors Association) - Standard of Installation.
- .3 NETA (International Electrical Testing Association) - ATS-2021 - 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 Megger test results.

- .3 Thermographic survey report.
- .4 Fire resistive cables: manufacturer's certification that the cables have been installed in accordance with the manufacturer's instructions.

1.05 Qualifications

- .1 Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

2 Products

2.01 Manufacturers

- .1 American Wire Group.
- .2 BICC Phillips.
- .3 General Cable.
- .4 Nexans.
- .5 Prysmian.
- .6 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.
- .2 Aluminum: Not permitted.

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°C, [600 V].
 - .6 Suitable for handling to -40°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°C, 1000 V.
- .6 Suitable for handling to -40°C.
- .7 For exterior installations, direct buried, or in conduit.
- .3 T90 Nylon:
 - .1 Single copper conductor.
 - .2 Thin wall PVC insulation with nylon covering.
 - .3 Rated for 90°C, 600 V.
 - .4 May be used up to size 10 AWG for interior installations.
 - .5 Base conduit fill on RW90 cable diameters.
 - .6 [Minimum 14 AWG for 15 A circuits in suites of residential occupancy.]

2.05 Armoured Cable

- .1 General
 - .1 Connectors: standard as required, complete with anti-short rings.
 - .2 Runs to be limited to fixture drops, and runs to devices in walls and partitions, maximum horizontal runs in exposed areas and ceiling spaces to be 1.8 m (6 ft).
 - .3 Do not daisy chain (leap frog) luminaires with armoured cable.
- .2 Type AC:
 - .1 Two, three or four copper conductors rated RW90, 1000 V.
 - .2 Bare copper ground wire.
 - .3 Insulation Voltage Rating: 600 V.
 - .4 Insulation Temperature Rating: 90°C (194°F).
 - .5 Insulation Material: Thermoplastic.
 - .6 Overall interlocked aluminum tape armour.
- .3 Type SPC90:
 - .1 Use for LED lighting, fluorescent dimming controls, and other SMART building applications.
 - .2 Colour coded cable with power, control, and signal under one cable.
 - .3 12-2C Power with a 16-2C Control.
 - .4 Bare copper ground wire.

- .5 Insulation Voltage Rating: 600 V.
- .6 Insulation Temperature Rating: 90°C (194°F).
- .7 Insulation Material: Thermoplastic.

2.06 Fire Resistive Cables

- .1 General:
 - .1 2 hour fire rating to CAN/ULC-S139 and to meet 2012 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 Mineral Insulated (MI) cable.
 - .2 VITALink MC Brand Type MC-RC90, manufactured by Marmon Wire & Cable Inc. (listed by ULC under ULC category code 'FHIT7' or 'FHJR7', dated 19 May 2015). This cable is not to be installed in conduit.
 - .1 Request quotation from manufacturer or manufacturer's representative for field certification of installed Vitalink cables prior to requesting Consultant's construction field review.
 - .2 Power cable must be installed according to UL protocol FHIT7.120 – Electrical circuit integrity systems certified in Canada.
 - .3 Prysmian Lifeline RC90 cable.
 - .1 Installation in accordance with UL protocol FHIT7-51, and FHIT7-51A.
 - .2 System makes use of Remke connectors and Resolve boxes, with no substitutions.
- .3 Substitution Limitations:
 - .1 Substitutions may only be considered by the Consultant if the product is listed by ULC under ULC Category Codes 'FHIT7' or 'FHJR7'.

2.07 TECK90 Cable

- .1 Single, three, or four conductors as indicated on drawings.
- .2 Cable to CSA C22.2 No. 131.
- .3 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .4 Insulation: Cross-linked polyethylene (XLPE), type RW90, rating: 600 V.

- .5 Inner jacket: polyvinyl chloride.
- .6 Armour: interlocking aluminum.
- .7 Overall covering: thermoplastic.
- .8 Fastenings:
 - .1 One-hole steel straps to secure surface cables 50 mm diameter and smaller. Two-hole steel straps for cables larger than 50 mm diameter.
 - .2 Channel type supports for two or more cables at 1500 mm centres.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .9 Connectors: Watertight, approved for TECK cable.

2.08 Conductor Pulling Lubricant

- .1 Where pulling lubricant is required, use non-wax based cable lubricants compatible with cable manufacturer recommendations, such as American Polywater.

2.09 Connectors

- .1 Armoured cable connectors must be proper squeeze type connectors and plastic anti-short bushings at terminations.
- .2 Connectors for conductors connecting to devices as per local governing electrical requirements to be equal to IDI Electric (Canada) Ltd., "Ideal" No. 451, No. 452, and No. 453, "Wing-Nut", CSA certified, 600 V, rated pressure type connectors.
- .3 For conductors sized 3/0 AWG and greater, provide long barrel double crimp, two (2) hole compression type lug connectors, unless otherwise noted.

2.10 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 6 AWG, 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.

3 Execution

3.01 Examination

- .1 Verify that field measurements are as indicated.
- .2 Wire and cable routing indicated is approximate unless dimensioned.

- .3 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
- .4 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%.
 - .2 Branch circuit conductors: maximum voltage drop of 3%.
- .5 Verify that mechanical work likely to damage wire and cable has been completed.
- .6 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 and per manufacturer's installation guidelines.
- .3 Conduit and cable supports:
 - .1 All wiring to be installed in EMT at all exposed areas 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 Use 10 AWG conductors for 20 A, 120 V 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 in) 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.

3.04 Conductors, Wires, and Cables

- .1 Provide fire rated conductors or provide a fire rated assembly around conductors used for life safety applications as described in 2012 OBC 3.2.7.10.
- .2 Indoor wiring installed in conduit, unless otherwise noted: 600 V "RW90 XLPE".
- .3 Wiring in channel back of fluorescent and LED lighting fixtures: 600 V type GTF or TEW.
- .4 Lighting and power branch circuit wiring:
 - .1 Copper, minimum 12 AWG.
 - .2 Home runs to lighting and receptacle panels, which exceed 22 m (75 ft) in length: minimum 10 AWG.
- .5 Size wires for 2 per cent maximum voltage drop to farthest outlet on a maximum 80% loaded circuit.
- .6 Outdoor wiring: "RWU90 XLPE".
- .7 Conductors shall be colour coded. Conductors 10 AWG and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size 8 AWG 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.
- .8 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.
- .9 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

3.05 Site Tests and Inspections

- .1 Perform continuity tests of all feeders, motor circuits, and branch circuits.
- .2 Perform insulation-resistance test (megger test) on each feeder. Submit report to the Consultant.

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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 0.3:09 (R2023), Test methods for electrical wires and cables.
 - .4 CSA C22.2 No. 48:15 (R2020), Nonmetallic sheathed cable.
 - .5 CSA C22.2 No. 51:2014, Armoured cables.
 - .6 CAN/CSA C22.2 No. 65-18 (R2022), Wire connectors (Trinational standard with NMJ-J-543-ANCE and UL 486A-486B).
 - .7 CSA C22.2 No. 75:17 (R2022), Thermoplastic insulated wires and cables.
 - .8 CSA C22.2 No. 208:18 (R2023), Fire alarm and signal cable.
- .2 NECA (National Electrical Contractors Association) – Standard of Installation.

1.03 Qualifications

- .1 Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.04 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 10 AWG 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 8 AWG or three 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 in) 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 27 05 26 – Grounding and Bonding for Communications Systems.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 0.4:17 (R2022), Bonding of electrical equipment.
 - .4 CSA C22.2 No. 41:22, Grounding and bonding equipment (Trinational standard with NMJ-J-590-ANCE and UL 467).
 - .5 CSA C22.2 No. 75:17 (R2022), 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 81-2012 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- .4 InterNational Electrical Testing Association (NETA):
 - .1 NETA ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

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 Qualifications

- .1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years' experience.

1.08 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 (Burndy).
- .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 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).

2.05 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.

2.06 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.

2.07 Mechanical Connectors

- .1 Material: Bronze.

2.08 Wire

- .1 Material: Stranded copper.
- .2 Foundation Electrodes: 2/0 AWG.
- .3 Grounding Electrode Conductor: Size to meet Ontario Electrical Safety Code requirements.

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 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.
- .6 Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- .7 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.
- .8 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.
- .9 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.
- .10 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.
- .11 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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (28th edition/2021).
- .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.

2.02 General

- .1 All supporting devices, strut channel, threaded rod, anchors, etc. to be used shall be of the "hot dipped" galvanized type. Electrogalvanized 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 in) 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 in) diameter steel threaded rod. Use clevis type attachment.

- .4 Provide minimum 100 mm (4 in) 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 Concrete Anchors

- .1 Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- .2 Drilled expansion anchors for anchors set in concrete block or poured concrete after the concrete has set. Size the insert and number of anchors so that the maximum load per anchor does not exceed the manufacturer's recommendation.
- .3 U-channel concrete inserts shall be 12 gauge steel 1-5/8 in square with insert anchors 1 3/8 in long and 100 mm (4 in) on centre.
- .4 Install anchor bolts to elevations required for proper attachment to supported equipment.

2.10 Plywood Equipment Boards

- .1 Plywood Equipment Boards: preservative treated, and kiln dried; thickness as indicated, or if not indicated, not less than 19 mm (3/4 in) deep. Provide marine grade plywood where subject to moisture conditions.
- .2 Paint plywood board white, or to match adjacent finishes. Leave the fire-retardant label unpainted for verification by the Consultant and by Authority Having Jurisdiction (AHJ).
- .3 Unless otherwise noted, boards shall be painted with two coats of good grade weatherproof flat gray non-conductive fire-retardant paint on all sides and edges (prior to mounting) and plumbed in a true vertical position. Provide nominal 13 mm (1/2 in) rustproof spacers between back of plywood and wall. Cut, fit, and place plywood equipment boards accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members. Attach to substrates as required to support

applied loads. Maintain at least 100 mm (4 in) from bottom of plywood equipment boards and the finished floor surface.

- .4 Unless directed otherwise in field, plywood equipment boards shall be 2440 mm (8 ft) high by 19 mm (3/4 in) deep by length shown on drawings (as dimensioned or as scaled) or length as required to accommodate equipment if not indicated on drawings. Unless directed otherwise in field, provide plywood equipment boards for all indoor surface mounted panelboards and systems "head-end" equipment for all applications where located in mechanical or electrical rooms/areas and only where specifically shown on drawings for all other applications.

2.11 Roof Supports

- .1 High-density polyethylene platform and base, height adjustable with rounded corners and edges to reduce likelihood of roof penetration.
- .2 Large surface area to spread the weight of supported objects including conduits, and cable trays over a large surface footprint.
- .3 No penetration of the waterproof membrane.
- .4 Self drains water, rot proof, and sunlight resistant.
- .5 Manufacturers:
 - .1 Thomas & Betts Superstrut Adjustable Universal Support.
 - .2 Eaton Dura-Blok series.

3 Execution

3.01 Installation

- .1 Obtain permission from the 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 in) off wall.
- .5 Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- .6 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.
- .7 Provide insets, holes, anchor bolts and sleeves in time when walls, floors, and roof are erected.
- .8 Place insets only in structural members and not in the finishing material.
- .9 Secure all supports and hangers to the structure unless noted otherwise.
- .10 Suspend hanger rods from approved concrete inserts and from beam clamps. Obtain Consultant's approval before welding to steel structural members.

- .11 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.
- .12 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.
- .13 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 Rigid metal conduit.
- .2 Flexible metal conduit.
- .3 Liquid tight flexible metal conduit.
- .4 Electrical metallic tubing (EMT).
- .5 Rigid PVC conduit.
- .6 Fittings and conduit bodies.

1.02 References

- .1 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 45.1:22 – Electrical rigid metal conduit – steel.
 - .4 CSA C22.2 No. 56-17 (R2022), Flexible metal conduit and liquid-tight flexible metal conduit.
 - .5 CSA C22.2 No. 83.1:07 (R2022), Electrical Metallic Tubing – Steel.
 - .6 CSA C22.2 No. 211.1-06 (R2021), Rigid types EB1 and DB2/ES2 PVC conduit.
 - .7 CSA C22.2 No. 211.2-06 (R2021), Rigid PVC (unplasticized) conduit.
 - .8 CSA C22.2 No. 227.1:19 (R2023), Electrical nonmetallic tubing.
 - .9 CSA C22.2 No. 227.2.1:19 (R2023), Liquid-tight flexible nonmetallic conduit.
 - .10 CSA C22.2 No. 2420-09 (R2019), Belowground reinforced thermosetting resin conduit (RTRC) and fittings.

1.03 Record Documentation

- .1 Accurately record actual routing of conduits larger than 51 mm (2 in).
- .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, if shown on drawings, is approximate unless dimensioned. Route as required to provide a 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 Rigid Metal Conduit

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel, threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Fittings and conduit bodies: Material to match conduit.

2.03 Flexible Metal Conduit

- .1 Flexible metal conduit: to CSA C22.2 No. 56, interlocked steel construction.
- .2 Fittings: CSA C22.2 No. 56.

2.04 Liquid Tight Flexible Metal Conduit

- .1 Description: Interlocked steel construction with PVC jacket.
- .2 Fittings: CSA C22.2 No. 56.

2.05 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.

2.06 Non-Metallic Conduit

- .1 Rigid Type EB1 PVC Conduit: to CSA C22.2 No. 211.1.

- .2 Rigid Type DB2/ES2 PVC Conduit: to CSA C22.2 No. 211.1.

2.07 Conduit, Fittings, and Accessories

- .1 Conduit accessories, conduits and fittings conforming to CSA Standard C22.2 No. 18-1972.
- .2 Provide rain tight connectors, couplings, fittings, junction boxes, pull boxes and surface outlet boxes shall be used for surface conduit installations exposed to moisture or in sprinklered buildings.
- .3 Rigid conduit bushings:
 - .1 Thomas & Betts Ltd. - Series 5031.
- .4 EMT Connectors:
 - .1 Thomas & Betts Ltd. - Steel City TC121A series.
- .5 Ground Bushings:
 - .1 Thomas & Betts – Blackjack or 1220 series.
- .6 Flexible conduit connectors:
 - .1 Thomas & Betts Ltd. - Series 3110.
 - .2 EMT couplings: steel concrete tight to match connectors.
- .7 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.
 - .1 Thomas & Betts – 8125 series.
- .8 Terminate EMT entering boxes or enclosures with nylon insulated steel concrete tight connectors.
- .9 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.
 - .1 Thomas & Betts – 5332 series.

3 Execution

3.01 Preparation

- .1 Produce layout sketches of conduit runs through mechanical and electrical service areas, through corridors, and other congested areas in order to resolve any interferences with other work, and to determine the most efficient route to run the conduit.

3.02 Installation

- .1 Minimum size: 21 mm (3/4 in) unless otherwise specified.
- .2 Conceal all conduit except in mechanical rooms and electrical rooms, or unless otherwise indicated in this specification, or noted on the drawings. Surface conduit work is not permitted unless specifically noted.
- .3 Install wiring in conduit unless otherwise specified. Where conduit sizes are not shown on drawings, provide conduits sized in accordance with Ontario Electrical Safety Code, CSA C22.1. When conduits are indicated, they are the minimum size required, and must be increased to suit the length of run or voltage drop requirements.
- .4 Conduit use:

- .1 Unless otherwise specified below or shown on the drawings, all systems shall be installed in electrical metallic tubing (EMT).
- .2 Equipment subject to vibration:
 - .1 Use liquid tight flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.
- .3 Outdoor locations, above grade: use rigid steel.
- .4 Underground: Use rigid PVC conduit for wiring in slabs on grade, and wiring below grade.
- .5 Wet and damp locations:
 - .1 Use rigid steel.
 - .2 Use liquid tight flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.
- .6 Dry locations:
 - .1 Concealed in metal stud partitions:
 - .1 Use electrical metallic tubing.
 - .2 Use of AC90 (Bx) as described in Section 26 05 19.
 - .2 Concealed in concrete: Use electrical non-metallic tubing or rigid PVC.
 - .3 Exposed areas: Use electrical metallic tubing.
 - .4 Use flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.
 - .5 Use liquid tight flexible metal conduit below raised floors for connections to all devices.
 - .6 Aluminium conduit may be used, in lieu of steel conduit, in clean and dry locations, but shall not be used in poured concrete, or for signal and intercommunication systems wiring.
 - .7 Raceways installed less than 2 m above grade in an area where they are subject to mechanical damage, shall be of the rigid steel type or protected by a steel guard of not less than no. 10 MSG, adequately secured in place.
 - .8 Use epoxy coated conduit in corrosive areas.
- .7 Equipment in sprinklered spaces:
 - .1 Provide CSA certified sealing rings for rigid steel galvanized conduit and CSA certified raintight connectors for steel galvanized electrical metallic tubing (EMT) where conduits enter the top or the sides of enclosures.
- .8 Telecommunications conduits: in accordance with Section 27 05 28.
- .5 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.
- .8 Remove wire used for temporary supports.
- .9 Do not attach conduit to ceiling support wires.
- .10 Route exposed conduit parallel and perpendicular to walls.
- .11 Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- .12 Route conduit in and under slab from point-to-point.
- .13 In damp and unheated areas, avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- .14 Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
- .6 Clearances:
 - .1 Maintain adequate clearance between conduit and piping.
 - .2 Maintain 300 mm (12 in) clearance between conduit and surfaces with temperatures exceeding 40°C.
- .7 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 or provide prefabricated conduit bends.
- .8 Install wall entrance seals where conduits pass through exterior walls below grade.
- .9 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.
- .10 Cut conduit square using saw or pipe cutter; de-burr cut ends.
- .11 Bring conduit to shoulder of fittings; fasten securely.
- .12 Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- .13 Use conduit hubs or sealing locknuts to fasten conduit and to cast boxes.
- .14 Provide suitable pull string in each empty conduit except sleeves and nipples.
- .15 Ground and bond conduit to Section 26 05 26.

- .16 Identify conduit to Section 26 05 53.
- .17 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.

3.03 Cleaning

- .1 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 Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 18.1:13 (R2022), Metallic Outlet Boxes (Tri-national standard, with UL 514A and ANCE NMJ-J-023/1).
 - .4 CSA C22.2 No. 40:17 (R2022), Junction and Pull Boxes.
 - .5 CSA C22.2 No. 85:14 (R2023) – 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. 18.1, 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. 18.1.

- .3 Cast Boxes: CSA C22.2 No. 18.1, 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. 18.1, galvanized steel.
- .2 Hinged Enclosures: As specified in Section 26 27 16.
- .3 Surface Mounted Cast Metal Box: CSA C22.2 No. 18.1, 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. 18.1.
- .2 Where 103 mm (4 in) 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 in) octagon or square, complete with fittings, where required to support fixtures.
- .4 Switch and receptacle boxes:
 - .1 103 mm (4 in) 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 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 in) 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 in) 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 ft) 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 in) 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 (6 in) separation. Provide minimum 600 mm (24 in) 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.
- .28 Provide painted cover plate screwed onto junction box to match adjacent material colour finish for all junction and outlet boxes. Where empty boxes or boxes allocated for future services are installed with conduit, provide cover plate. If the box is provided a circuit, provide circuit label in accordance with Section 26 05 53.

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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 National Electrical Manufacturer's Association (NEMA)
 - .1 ANSI/NEMA WD 6-2021: Wiring Devices – Dimensional Specifications.
 - .2 ANSI/NEMA 250-2020: Enclosures for Electrical Equipment.
 - .3 UL 94, Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances testing.
- .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 UL 94V-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 Single Channel Metal Raceway

- .1 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 colour 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 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 Basis of Design: Wiremold 500 and 700 series.

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 ft) 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 Sleeves, sealing of sleeves and openings, as required for all electrical work.

1.02 References

- .1 CAN/ULC-S101-14, Standard methods of fire endurance tests of building construction and materials.
- .2 CAN/ULC-S115:2013, Standard method of fire tests of firestop systems.

1.03 Submittals

- .1 Submit data sheets for firestopping in accordance with Section 01 33 00.
- .2 Submit copies of firestopping drawings with ULC certificate and system number for each specific installation.
- .3 Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- .4 Submit dimensioned location drawings indicating required sleeves and formed openings in structural poured concrete or precast concrete construction or in roofing, and locations of cutting or drilling required for Electrical work.

2 Products

2.01 Sleeves

- .1 Galvanized steel sleeves:
 - .1 24 gauge with an integral flange at one (1) end to secure sleeve to formwork construction.
 - .2 Schedule 40 pipe.
- .2 Schedule 40 PVC sleeves.

2.02 Sleeve Seals

- .1 Manufacturers
 - .1 Hilti Canada.
 - .2 Specified Technologies Inc.
 - .3 3M Canada Inc.
 - .4 Tremco.
 - .5 A/D Fire Protection Systems.
 - .6 Nelson.
- .2 Asbestos-free, elastomeric materials and intumescent materials, tested, listed, and labelled by ULC in accordance with CAN/ULC-S101, and CAN/ULC-S115 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) no less than fire rating for surrounding construction.

- .3 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. Coordinate material requirements with trades supplying abutting areas of materials.
- .4 Maintain fire rating of separation in accordance with architectural drawings.

3 Execution

3.01 Installation

- .1 Where conduits and conductors pass through structural poured concrete, provide sleeves of type suitable for application, and approved by local governing codes.
- .2 Sleeves in concrete slabs, except as noted below, are to be 24 gauge or equivalent, with an integral flange to secure sleeves for formwork construction.
- .3 Sleeves in waterproof concrete slabs and in other slabs where waterproof sleeves are required are to be lengths of Schedule 40 pipe sized to extend 100 mm (4 in) above floor.
- .4 Sleeves in poured concrete walls and foundation are to be Schedule 40 pipe.
- .5 Through interior walls, use standard weight steel pipes, conduit, or galvanized steel. Cut flush with finished surfaces. Check room finish schedules.
- .6 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.
- .7 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 in) above finished floors, and cut flush with underside of floor.
- .8 Size sleeves, unless otherwise noted, to leave 13 mm (1/2 in) clearance around conduit, duct, conductor, etc. Void between sleeves and conduit, duct, conductors, etc., to be packed and sealed for length of sleeves as in accordance with article entitled "Sleeve Seals" specified in this Section. Pack and seal sleeves set in exterior walls with governing authority approved materials suitable for application and pack both ends of sleeves watertight with approved permanently flexible and water tight materials. Coordinate exact responsibility of work with General Trades Contractor.
- .9 Submit to concrete reinforcement detailer at proper time, drawings indicating required sleeves, recesses and formed openings in poured concrete work. Completely and accurately dimension such drawings and relate sleeves, recesses and formed openings to suitable grid lines and elevation datum.
- .10 Supply sleeves of a water protecting type in accordance with detail found on drawings for installation in following locations:
 - .1 in Mechanical and Fan 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.
- .11 "Gang" type sleeving to be permitted only with approval of Owner and reviewed with the Consultant.
- .12 Terminate sleeves for work which is exposed, so that sleeve is flush at both ends with wall, partition, or slab surface such that sleeve may be covered completely by escutcheon plates.

- .13 Sleeves are not required in interior walls and dry area floors where conduit is installed ahead of floor construction.
- .14 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.
 - .3 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.
 - .4 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.
- .15 Provide all flashing and waterproofing for sleeves through roof and exterior walls to the requirements of Division 07.
- .16 Firestop sleeves in accordance with the manufacturer's specifications and recommendations.

End of Section

1 General

1.01 Section Includes

- .1 Tested firestop systems used in penetrations for the passage of cables, conduit, and other electrical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

1.02 Related Requirements

- .1 Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
 - .1 Section 07 84 00 – Firestopping.
 - .2 Section 27 05 44 – Sleeves and Sleeve Seals for Communications Pathways and Cabling.

1.03 References

- .1 Underwriter's Laboratories (UL) and Underwriters Laboratories of Canada (ULC):
 - .1 Test Requirements: CAN/ULC-S115:2023, Standard Method of Fire Tests of Firestop Systems.
 - .2 Underwriters Laboratories of Canada (ULC) runs CAN/ULC-S115:2023 under their designation of ULC-S115:2023 and publishes the results in their "FIRE RESISTANCE RATINGS DIRECTORY" that is updated annually.
 - .3 Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually. UL tests that meet the requirements of ULC-S115 are given a cUL listing and are published by UL in their "Products Certified for Canada (cUL) Directory."
 - .4 CAN/ULC-S101-14, Fire Endurance Tests of Building Construction and Materials.
 - .5 CAN/ULC 102:2019 (R2024), Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 ASTM:
 - .1 Omega Point Laboratories runs ASTM E814 and publishes the results annually in their "Omega Point Laboratories Directory".
 - .2 Inspection Requirements: ASTM E2174, "Standard Practice for On-site Inspection of Installed Fire Stops.", and ASTM E2393 Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
 - .3 Test Requirements: ASTM E2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus".
 - .4 ASTM D6904, "Standard Practice for Resistance to Wind Driven Rain for Exterior Coatings Applied on Masonry".
 - .5 ASTM C679, "Standard Test Method for Tack-Free Time of Elastomeric Sealants".
- .3 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.
- .4 Ontario Building Code.
- .5 Ontario Electrical Safety Code.

1.04 Definitions

- .1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.05 Submittals

- .1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 33 00.
- .2 Manufacturer's engineering judgment identification number and drawing details when no ULC or cUL system is available for an application. Engineered judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- .3 Submit material safety data sheets provided with product delivered to project site.
- .4 Submit shop drawings in accordance with Section 01 33 00:
 - .1 Submit complete cUL, ULC, or equivalent approved systems for all applications. Ensure the listing is clearly noted on the submittal.

1.06 Closeout Submittals

- .1 On completion of firestopping and smoke sealing installation, submit a Letter of Assurance to the Consultant certifying the firestopping and smoke sealing installation has been carried out throughout the building to electrical service penetrations and that installation has been done in strict accordance with requirements of the Ontario Building Code, any applicable municipal bylaws, ULC requirements, and manufacturer's instructions.

1.07 Quality Assurance

- .1 Fire-Test-Response Characteristics: Provide through-penetration fire stop systems and fire-resistive joint systems that comply with specified requirements of tested systems.
- .2 Firestop System installation must meet requirements of CAN/ULC-S115 tested assemblies that provide a fire rating as shown in Section 2.1 Clauses 4, 5, 6, and 7 below.
- .3 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- .4 Firestop Systems do not re-establish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- .5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

1.08 Installer Qualifications

- .1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary training to install manufacturer's products per specified requirements. A supplier'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 Installation Responsibility: assign installation of through-penetration fire stop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor.
- .3 The work is to be installed by a contractor with at least one of the following qualifications:
 - .1 FM 4991 approved contractor.
 - .2 ULC approved contractor.
 - .3 Manufacturer's accredited fire stop specialty contractor.
- .4 Installer: Minimum 3 years experience with fire stop installation.

1.09 Delivery, Storage, and Handling

- .1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.
- .2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at project site.
- .3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- .4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- .5 Do not use damaged or expired materials.

1.10 Project Conditions

- .1 Do not use materials that contain flammable solvents.
- .2 Scheduling
 - .1 Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
 - .2 Schedule installation of Drop-In firestop devices after placement of concrete but before installation of the pipe penetration. Diameter of sleeved or cored hole to match the listed system for the device.
 - .3 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- .3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- .4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- .5 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

2 Products

2.01 Performance Requirements

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- .3 Provide a round fire-rated cable management device whenever cables penetrate fire rated walls, where frequent cable changes and additions may occur. The fire-rated cable management device shall consist of a corrugated steel tube with zinc coating, contain an inner plastic housing, intumescent material rings, and inner fabric smoke seal membrane. The length of the sleeve shall be 315 mm (12.4 inches). The fire-rated cable management device shall contain integrated intumescent firestop wrap strip materials sufficient to maintain the hourly rating of the barrier being penetrated. The fire-rated cable management device shall contain a smoke seal fabric membrane or intumescent firestop plugs sufficient to achieve the L-Rating requirements of the barrier type. Install device per the manufacturer's published installation instructions.
- .4 Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with CAN/ULC-S115. For penetrations through a Fire Wall or horizontal Fire Separation provide a firestop system with a "FT" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.
- .5 W-ratings: in accordance with Section 07 84 00.
- .6 Provide a firestop system with an Assembly Rating as determined by CAN/ULC-S115 which is equal to the time rating of construction joint assembly.
- .7 Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with CAN/ULC-S115.
 - .1 L-Rating: Not exceeding 5.0 CFM/sqft of penetration opening at both ambient and elevated temperatures.
- .8 Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of [0] as determined by ASTM G21.
- .9 Rain and water resistance: provide perimeter joint sealant tested in accordance with ASTM D 6904 with less than 1 hour tack free time as tested in accordance with ASTM C 679.

2.02 Manufacturers

- .1 Manufacturer List:
 - .1 AD Fire Protection Systems.
 - .2 Hilti (Canada) Corporation
 - .3 3M.
 - .4 Specified Technologies, Inc. (STI).
 - .5 Tremco, Inc.

- .2 Substitutions: Where a specific manufacturer is noted in this Section, equivalent products from the manufacturers listed above may be used, subject to compliance with through penetration firestop systems and joint systems listed in the ULC Fire Resistance Directory – Volume III, or UL Products Certified for Canada (cUL) Directory.

2.03 Materials

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- .2 Accessories: provide components for each firestopping and smoke seal systems that are needed to install fill materials. Use only components specified by firestopping material manufacturer, and approved by the qualified testing agency. Accessories include, but are not limited to, the following items:
 - .1 Permanent forming, damming, and backing material.
 - .2 Temporary forming material.
- .3 Pre-formed firestop devices for use with non-combustible and combustible pipes (closed and open systems), conduit and/or cable bundles penetrating concrete floors and/or gypsum walls:
 - .1 Hilti Tub Box Kit (CP 681) for use with tub installations.
 - .2 Hilti Cast-In Place Firestop Device (CP 680-PX) for use with XFR pipe.
 - .3 Hilti Cast-In Place Firestop Device (CP 680-M) for use with non-combustible penetrants.
 - .4 Hilti Speed Sleeve (CP 653) for use with cable penetrations.
 - .5 Hilti Firestop Drop-In Device (CFS-DID) for use with non-combustible and combustible penetrants.
 - .6 Hilti Cast-in Firestop sleeve (CFS-CID MD P) and (CFS-CID MD M) for use with combustible and non-combustible pipes through metal deck.
 - .7 Hilti Firestop Block (CFS-BL).
 - .8 STI SpecSeal series SSC Firestop Collars.
 - .9 STI SpecSeal series LCC Firestop Collars.
- .4 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT).
 - .1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).
 - .2 Hilti Fire Foam (CP 620)/CP 660.
 - .3 Hilti Flexible Firestop Sealant (CP 606).
 - .4 Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
 - .5 Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
- .5 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe.

- .1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).
- .6 Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles.
 - .1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).
 - .2 Hilti Fire Foam (CP 620)/660.
 - .3 Hilti Flexible Firestop Sealant (CP 606).
 - .4 Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
 - .5 Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
- .7 Firestop Putty Pads: Intumescent, non-hardening putty pads to be installed on metallic and non-metallic electrical switch and receptacle boxes to reduce horizontal separation between boxes to less than 610 mm (24 in):
 - .1 STI SpecSeal Series SSP Firestop Putty Pads.
 - .2 Hilti Firestop Putty Pad (CP 617).
- .8 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
 - .1 Hilti Firestop Block (CFS-BL).
 - .2 Hilti Composite Sheet (CFS-COS).
 - .3 Hilti Firestop Mortar (CP 637).
 - .4 Hilti Fire Foam (CP 620)/660.
 - .5 Hilti Firestop Board (CP 675T).
- .9 Non-curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
 - .1 Hilti Firestop Block (CFS-BL).
 - .2 Hilti Firestop Board (CP 675T).
- .10 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls.
 - .1 Hilti Speed Sleeve (CP 653) with integrated smoke seal fabric membrane.
 - .2 Hilti Firestop Cable Collar (CFS-CC).
 - .3 Hilti Firestop Sleeve (CFS-SL SK).
 - .4 Hilti Retrofit Sleeve (CFS-SL RK) for use with existing cable bundles.
 - .5 Hilti Gangplate (CFS-SL GP) for use with multiple cable management devices.
 - .6 Hilti Gangplate Cap (CFS-SL GP CAP) for use at blank openings in gangplate for future penetrations.

- .11 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected.
 - .1 Hilti CFS-BL Firestop Block (for walls and floors).
 - .2 Hilti CFS-PL Firestop Plug (for walls and floors).
- .12 Cast-In-Place Firestop Device: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket. Device shall allow for a concrete floor thickness of minimum 63 mm (2-1/2 in) up to 914 mm (36 in) without the use of field applied extension tubing:
 - .1 STI SpecSeal CID Cast-In Firestop Device.
 - .2 Hilti CP 680 Cast-In Place Firestop Device (for floors only).
- .13 For single or cable bundles up to 25 mm (1 in) diameter penetrating gypsum, masonry, concrete walls or wood floor assemblies.
 - .1 Hilti CFS-D Firestop Cable Disc.

3 Execution

3.01 Installers

- .1 Labour Use to Install Firestop Systems
 - .1 To ensure complete harmony on the project site, the installation of each scope of work is to be performed jurisdictionally correct per existing trade agreements.

3.02 Preparation

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .1 Verify penetrations are properly sized and in suitable condition for application of materials.
 - .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 - .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
 - .5 Do not proceed until unsatisfactory conditions have been corrected.

3.03 Coordination

- .1 Coordinate construction of openings, penetrations to ensure that the fire stop systems are installed according to specified requirements.
- .2 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems.
- .3 Coordinate fire stopping with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems.

- .4 Do not cover up through-penetration fire stop and joint system installations that will become concealed behind other construction until each installation has been examined by the building inspector.

3.04 Installation

- .1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory or Omega Point Laboratories Directory.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.
 - .1 Seal all holes or voids made by penetrations to ensure an air and water-resistant seal.
 - .2 Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - .3 Protect materials from damage on surfaces subjected to traffic.

3.05 Field Quality Control

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by applicable code authorities.
- .3 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops", or other recognized standard.
- .4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- .5 Manufacturer's Field Services: During Installation, provide periodic destructive testing inspections to assure proper installation/application. After installation is complete, submit findings in writing indicating whether or not the installation of the tested system identified was installed correctly.

3.06 Identification and Documentation

- .1 The firestop contractor is to supply documentation for each single application addressed. This documentation is to identify each penetration location on the entire project.
- .2 The Documentation Form for through penetrations is to include:
 - .1 A Sequential Location Number.
 - .2 The Project Name.
 - .3 Date of Installation.
 - .4 Detailed description of the penetration location.
 - .5 Tested System or Engineered Judgment Number.
 - .6 Type of assembly penetrated.
 - .7 A detailed description of the size and type of penetrating item.
 - .8 Size of opening.
 - .9 Number of sides of assemblies addressed.

- .10 Hourly rating to be achieved.
- .11 Installer's Name.
- .3 Copies of these documents are to be provided to the general contractor at the completion of the project.
- .4 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - .1 The words: "Warning-Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
 - .2 Contractor's Name, address, and phone number.
 - .3 Through-Penetration firestop system designation of applicable testing and inspecting agency.
 - .4 Date of Installation.
 - .5 Through-Penetration firestop system manufacturer's name.
 - .6 Installer's Name.

3.07 Adjusting and Cleaning

- .1 Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
- .2 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

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 03 30 00 – Cast-in-Place Concrete.
- .2 Section 26 27 26 – Wiring Devices.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.2 No. 42-10 (R2020), General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CSA C22.2 No. 42.1-13 (R2017), Cover plates for flush-mounted wiring devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No. 55-15 (R2020), Special Use Switches.
 - .4 CSA-C22.2 No. 111-18 (R2023), General-Use Snap Switches (Trinational standard with UL 20 and NMX-J-005-ANCE).

1.04 Submittals

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.

2 Products

2.01 Outdoor Receptacle Pedestals

- .1 Aluminum pedestal complete with pedestal cap, gaskets, grounding lug, and all require accessories.
- .2 Minimum 75 mm by 75 mm (3 inch by 3 inch) cross section.
- .3 Drain hole.
- .4 Final mounting height of wiring device shall be no greater than 1200 mm above finished grade, including concrete base.
- .5 Pedestal will be approved using field evaluation or special inspection and marked by a certification organization accredited by (SCC) standards council of Canada such as "CSA" or "QPS" or "ESA" or "ENTELA" or "UL".
- .6 Complete with base flange for concealing anchor bolts.
- .7 Receptacles to be oriented minimum 45 degrees down from horizontal to minimize cable strain.
- .8 Provide bracket for management of cables, or coiling of excess cable length.

2.02 Foundations for Pedestals

- .1 Provide foundations for lighting standards in accordance with manufacturer's recommendations. Submit Equipment Foundation Data in accordance with referenced standards in this section.

- .2 Concrete Foundations:
 - .1 Provide concrete bases as specified in Section 03 30 00.
- .3 Anchor Bolts
 - .1 Provide concealed galvanized high strength steel rod anchor bolts, in accordance with manufacturer's instructions.

2.03 Special Receptacles

- .1 Voltage and configurations as indicated on drawings.
- .2 Receptacles of one manufacturer throughout project.

2.04 Receptacle Cover Plates

- .1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 While-in-use weatherproof cover spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches for outdoor applications. Cover shall be suitable for wet locations whether or not a plug is inserted in the receptacle.
- .4 All outdoor wiring device cover plates to be labeled with riveted 3-ply engraved laminated nameplate identifying panel and circuit number for each device, and receptacle configuration.

3 Execution

3.01 Installation

- .1 Receptacle Pedestal
 - .1 Cut opening required on gasket for wiring access and concrete screw holes.
 - .2 Install galvanized steel concrete screws to secure pedestal to concrete base.
 - .3 Apply a bead of sealant at top of pedestal for weatherproofing.
 - .4 Ground pedestal in accordance with Section 26 05 29.
 - .5 Install receptacles as indicated.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 as indicated.
- .3 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.

3.02 Waste Management

- .1 Separate and recycle waste materials in accordance with Division 01.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Owner's Representative.

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 Division 09 – Finishes.
- .2 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 Group 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 the Consultant 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 reviewed by the Consultant prior to manufacturing.
 - .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 and Box Markers

- .1 Colour code conduits, boxes, and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 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.
- .4 Confirm colours with the Consultant prior to commencing rough-in.

2.05 Junction and Pull Boxes

- .1 Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting outside of covers.
- .2 Spray painting: not permitted.
- .3 Paint colours to be in accordance with following schedule:
 - .1 Lighting: yellow.

- .2 Normal power: blue.
- .3 Emergency power: orange.
- .4 Fire alarm: red.
- .5 Communications systems including telephone and data: green.
- .6 Miscellaneous signals: brown.
- .4 In addition to painting miscellaneous signal boxes, clearly identify specific system in which box is installed. Identify source panelboard for power circuits.

2.06 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.

2.07 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 and Box 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 15 m (50 ft) along every exposed conduit, duct or cable run exceeding 15 m (50 ft) in length.
 - .4 At every access point on concealed conduit duct or cable.
 - .5 At each junction box.
- .2 Place labels so as to be visible from 1500 mm (5 ft) 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 in) 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 Provide a short circuit and coordination study for the existing and new portions of electrical distribution system. The basic analysis shall include a protective device evaluation, and a protective device coordination study.
- .2 The project shall begin at the point of utility service for the facility and continue down through the system to all downstream distribution and branch panelboards, motor control centres and significant motor locations.
- .3 The project shall include any new generators and any associated emergency power distribution equipment, including automatic transfer switches and generator ground fault protection.

1.02 Related Requirements

- .1 Section 26 05 73.19 – Arc-Flash Hazard Analysis.
- .2 Single Line Diagram.

1.03 Reference Standards

- .1 American National Standards Institute (ANSI):
 - .1 ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - .2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
 - .3 ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
 - .4 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
- .2 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 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
 - .3 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - .4 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
 - .5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

1.04 Submittals

- .1 In accordance with Division 01:
- .2 Submit the following:
 - .1 Submit for review three copies of the protection coordination study.

- .2 Shop drawings for equipment affected by the coordination study will not be reviewed until the coordination study has been submitted and reviewed.
- .3 Include a one-line diagram of the system.
- .4 Bind the final report in a three-ring binder, as well as a soft copy.
- .3 Projection System Coordination:
 - .1 Prepare a graph or coordination curves, prior to manufacture of service entrance and distribution equipment on K & E No. 336E Time-Current characteristic graph paper. Time-current characteristics shall be plotted of the following:
 - .1 Supply Authorities relays or fuses protecting incoming service (Contractor under this section shall obtain this information).
 - .2 Main and feeder protective devices at every voltage level used in distribution system.
 - .3 Protective devices associated with largest motor and/or refrigeration compressor.
 - .2 Preliminary submission of graph for comment will be accepted. Submit graph to Supply Authority for approval by them as providing satisfactory co-ordination. When curves have been approved by Supply Authority, they shall be submitted for approval. After approval has been obtained, order protective devices, and calibrate to conform with these curves.
 - .3 Each time-current characteristic curve sheet shall include:
 - .1 A single line diagram for the portion of the system involved.
 - .2 Transformer damage curves (where applicable).
 - .3 Cable damage curves (where applicable).
 - .4 Available fault levels for the portion of the system involved.
 - .4 Consult manufacturer of the refrigeration compressors and obtain recommendations for settings on starters. Incorporate information in co-ordination curves and submit the associated curves to Compressor Manufacturer and obtain approval from the manufacturer.
 - .5 Compressor manufacturer and mechanical trade contractor will determine and calibrate proper protection on motor starters and will ensure that it coordinates with protective devices on switchboard.
 - .6 Co-ordination curves, mentioned above, shall be prepared by distribution equipment manufacturers as soon as possible after award of contract.
 - .7 At the option of this contractor under this section, these co-ordination curves may also be prepared by an independent testing organization. In this case, the independent testing organization shall determine the proper settings of all protective relays and devices and pass them on to the switchboard manufacturer for incorporation into the switchboards. Include all associated costs in the tender.
 - .8 Distribution Equipment manufacturers shall examine drawings and specifications prior to award of contract to ensure that relays and devices being supplied by them will co-ordinate satisfactorily to Supply Authority requirements. Payment will not be allowed, after award of contract, for extra charges due to device changes to comply with recommended practices, due to oversight or negligence by distribution equipment manufacturers.

1.05 Closeout Submittals

- .1 The Engineer who prepared the report shall visit the site and confirm that the feeder sizes as installed are consistent with the report as submitted.
- .2 Submit final version of the report with as-constructed feeder lengths and feeder sizes.

1.06 Quality Assurance

- .1 Preparer Qualifications: Firm experienced in the analysis, evaluation, and coordination of electrical distribution systems and similar to the system for this project.
- .2 The study shall be prepared in accordance with the latest edition of NETA ATS, the Canadian Electrical Code, as well as manufacturer's recommendations.
- .3 Short-Circuit Analysis and Coordination Study shall be performed by a registered Professional Engineer. Study shall be signed and sealed by the Engineer. The Engineer shall have a minimum of eight years experience in the analysis, evaluation, and coordination of electrical distribution systems.
- .4 The firm conducting the study shall have one million worth of Professional Liability Insurance in addition to standard general insurance.

2 Products

2.01 Manufacturers

- .1 Independent Testing Organizations
 - .1 AC Tesla.
 - .2 Brosz and Associates.
 - .3 C-INTECH.
 - .4 Eastenghouse.
 - .5 G.T. Wood.
 - .6 Haronitis and Associates Ltd.
 - .7 Qualus (formerly Enkompass).
- .2 Electrical distribution manufacturers:
 - .1 Eaton.
 - .2 Schneider Electric.

2.02 Protective Device Coordination Study

- .1 Prepare coordination time-current characteristic curves to determine the required settings/sizes of the protective devices to maximize selectivity. The utility upstream protective device feeding the facility shall be maintained as the upper limit for coordination. These settings shall be obtained by the preparer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and illustrate adequate clearing times between series devices. The curves shall be created through the use of the study software package, but must reflect actual protective devices to be installed.

Adequate time-current curves shall be generated to depict coordination. In addition, protective device characteristics shall be suitably determined to reflect calculated short-circuit levels at the location.

- .2 A narrative analysis shall accompany each coordination curve sheet and describe the coordination and protection in explicit detail. All curve sheets shall be multi-colour for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide solution to resolve situation. System coordination, recommended ratings, and setting of protective devices shall be accomplished by a registered professional electrical engineer with a minimum of eight years of current experience in the coordination of electrical power systems.
- .3 The following information shall be provided on all curve sheets:
 - .1 Device identification and associated settings/size.
 - .2 Voltage at which curves are plotted.
 - .3 Current multiplier.
 - .4 ANSI frequent fault damage curve.
 - .5 Cable insulation damage curves.
 - .6 Transformer inrush point.
 - .7 Single-line for the portion of the system.
 - .8 Motor starting profiles (where applicable).

2.03 Single Line Diagram

- .1 The final report shall include a multi-colour single line diagram of the electrical distribution system within the scope of the project. The single line diagram shall include:
 - .1 Transformer rating, voltage ratio, impedance, and winding connection.
 - .2 Feeder cable phase, neutral and ground sizes, length of cable, conductor material, and conduit size and type.
 - .3 Switchgear, switchboards, panelboards, MCC's, fuses, circuit breakers, ATS's and switches continuous current ratings.
 - .4 Protective relays with appropriate device numbers and CT's and PT's with associated ratios.
 - .5 Detailed legend indicating device type identification and other significant details.

3 Execution

3.01 Examination

- .1 Obtain fault level and X/R ratio information from the utility.

3.02 Summary

- .1 The results of the system studies shall be summarized in a final report.
- .2 Where required, copies of the final report shall be submitted to the Supply Authority for their review and approval. Submit approved copies of the report to the Consultant.

3.03 Adjusting

- .1 The contractor shall engage the manufacturer's service group or alternately a qualified independent testing firm to perform field adjustments of the protective devices as required for placing the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study and protective device evaluation / coordination study.
- .2 Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved protective device coordination study, shall be carried out by manufacturer's service group.
- .3 Submit a final service report confirming that settings have been completed.

End of Section

1 General

1.01 Section Includes

- .1 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 version 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 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 C37.010-2016 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - .4 ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- .3 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA Z462:21, 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 licensed Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- .2 The licensed Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.
- .3 The licensed Professional Electrical Engineer shall have a minimum of eight (8) years of experience in performing power system studies.
- .4 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

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 G.T. Wood.
 - .6 Haronitis and Associates Ltd.
 - .7 Qualus (formerly Enkompass).
- .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 90 mm (3.5 in) by 125 mm (5 in) 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 centre, 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.
- .2 Conduit rough-ins for future equipment.

1.02 Related Requirements

- .1 Division 08 – Openings.
- .2 Division 11 – Equipment.
- .3 Division 14 – Conveying Equipment.
- .4 Division 20 – Common Mechanical Requirements.
- .5 Section 20 05 13 – Common Motor Requirements for Mechanical Equipment.
- .6 Division 21 – Fire Suppression.
- .7 Division 22 – Plumbing.
- .8 Division 23 – Heating, Ventilating, and Air Conditioning.
- .9 Division 25 – Integrated Automation.

1.03 References

- .1 NEMA WD 1 - General Color Requirements for Wiring Devices.
- .2 NEMA WD 6 - Wiring Devices - Dimensional Specifications.

1.04 Coordination

- .1 Coordinate work to Division 01.
- .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 Division 01.
- .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 V.
- .2 Motors 1/2 hp and above shall be 3 phase, 60 Hz, 575 V or 208 V.

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 Conduit Pathways and Rough-Ins

- .1 Where drawings indicate to rough-in conduits for future equipment, or equipment to be provided by the Owner, or other systems as noted on the plans, provide pull string in the conduit, and tag the conduit for the reserved future use/purpose.
- .2 Where circuits breakers, disconnect switches, or other electrical distribution is provided for future equipment, tag the devices with the reserved future use/purpose.

3.02 Wiring of Equipment Provided Under Other Divisions

- .1 Use the following procedures for 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 (MCC), or VFD. Extend wiring from starter, MCC, 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 Doors
 - .1 Ascertain exact locations of door operators, actuator push buttons, automatic sensors, and other door hardware.
 - .2 Locate power door operator actuators not less than 600 mm and not more than 1500 mm beyond the door swing where the door opens towards the control.
 - .3 Provide branch circuit wiring for door operators.
 - .4 Provide control and control wiring for all low voltage door interconnections.
- .9 Conveying Equipment (e.g. Elevators): in accordance with Section 26 05 83.14.
- .10 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.
- .11 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.

- .4 [Provide 120 V power connections to small exhaust fans, and ceiling fans for all line voltage control devices, including but not limited to wiring through toggle switches, line voltage thermostats, countdown timer switches, or line voltage speed controllers. Refer to mechanical drawings and schedules for control devices and coordinate requirements with HVAC Division.]
- .5 Provide 120 V wiring connections to duplex receptacles integral with air handling unit control panels.
- .6 Provide 120 V wiring connections to HVAC maintenance receptacles integral with roof mounted HVAC equipment.
- .7 Provide 120 V wiring connections to lighting fixture/switch combinations integral with air handling units.
- .12 Integrated Automation (Building Automation System)
 - .1 Refer to drawing notes for requirements.
 - .2 Provide 120 V wiring connections to BAS system controllers/panels and other control system or component requiring 120 V power including, but not limited to, VAV boxes, dampers, low voltage transformers, etc.
 - .3 From equipment as noted on drawings, extend suitable wiring in conduit from equipment contacts to designated BMS panel serving area, terminating wiring and conduit in a junction box. Leave wiring un-terminated with slack coiled length of minimum 2 m (6 ft) long. Clearly label junction box and wiring end for termination onto BMS panel by respective Mechanical Trade.

3.03 Examination

- .1 Verify that equipment is ready for electrical connection, wiring, and energization.

3.04 Electrical Connections

- .1 Provide a local disconnect switch for all equipment, regardless of if a disconnect switch is shown or not shown on the plans.
- .2 Make electrical connections to equipment manufacturer's instructions.
- .3 Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.
- .4 Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- .5 Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.
- .6 Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- .7 Install disconnect switches, controllers, control stations, and control devices as indicated.
- .8 Modify equipment control wiring with terminal block jumpers as indicated.

- .9 Provide interconnecting conduit and wiring between devices and equipment where indicated.

End of Section

1 General

1.01 Summary

- .1 This Section includes control sequences for lighting systems, subsystems, and equipment.
- .2 System Overview:
 - .1 The main lighting control system shall be a digitally distributed system consisting of individually addressable control devices with local over-ride control stations, astronomical time clock, occupancy sensor, and photo sensor interfaces.
 - .2 Refer to the Electrical Lighting drawings for additional information regarding specific specifications and locations of equipment and devices.

2 Products

2.01 Systems

- .1 Hardware Description:
 - .1 The basis of design of the digitally distributed control system shall consist of central control software linked to the owner's intranet to allow access to the control system software via a host server computer on the owner's intranet, and then accessible by any computer via a web browser with network access, the correct IP address and password. The central control software shall feature an astronomical time clock, schedule masking functions, prioritization of inputs, blink-warn function, and ability to communicate with all system zones and individual fixtures for monitoring and trending.
 - .2 Emergency powered/egress luminaires shall be controlled via an associated I/O module. These modules shall allow the emergency egress luminaires to be switched "ON" and "OFF" and allow dimming under normal power conditions, and force emergency luminaires to full output "ON" upon loss of normal power as long as the emergency power source is active.
 - .3 Basis of design for the local occupancy sensors shall be a series of passive infrared (PIR) wall box low voltage occupancy sensors and ultrasonic ceiling mount occupancy sensors. Low voltage devices shall be powered via standard CAT-5 low voltage cabling with RJ-45 connectors.
 - .4 Over-ride switches shall have the appearance of a classic rocker switch with ON, OFF, and dimming capabilities and providing LED user feedback. Switches shall be one button per gang, flush mount with white screwless plastic Decora style cover-plates. Each button shall have a colored indicator lamp to indicate the status of the control zone assigned to that button.
 - .5 The system shall be capable of executing a blink warn function for each zone prior to shutting the lights off. If a tenant cycles their local over-ride switch during the blink warn timeout the tenant shall get an additional time frame of "after hours lights on" as arranged with the owner (2 hour maximum override time setting).
 - .6 The daylight harvesting sensor for dimmable control shall be a simple 0-10V current sensor. This daylight sensor is compatible with any standard 0-10V dimming ballast available commercially from many ballast manufacturers. However, the preferred and specified ballast is Philips Advance Mark VII 0-10 V dimming ballast.

2.02 Operation

- .1 Night Lights

- .1 Night lights shall have separate operational intents for daytime and nighttime hours.
 - .1 During daytime hours of operation indicated night lights shall function the same as the other fixtures in the corresponding zone.
 - .1 When the fixtures in the zone are switched ON or dimmed by local control devices, the night lights shall operate accordingly.
 - .2 After hours, night lights shall remain ON to function as security lighting.
- .2 Lighting Controls
 - .1 The lighting system is designed to meet the needs of the occupants by providing manual control and flexibility while constantly monitoring the occupancy and therefore the need for lighting in each space.
 - .1 Seminar and classrooms have multiple switching zones, some with dimming capability, to accommodate the various user functions.
 - .2 All spaces, excluding the lobby, entry vestibules, generator, IT and electrical rooms, shall be provided with wall or ceiling mounted occupancy sensors to automatically turn lights OFF when unoccupied.

3 Execution

3.01 Sequence of Operation

- .1 The following is a space-by-space breakout of the lighting system and associated controls for each space type. Note that the given illuminance levels are maintained averages for that given space.
 - .1 Classrooms:
 - .1 Means of Illumination:
 - .1 The Classrooms are designed to have multiple layers of illumination that are individually controlled to provide adjustability to meet various user needs. The layers of illumination include:
 - .1 Overhead Ambient/Task Illumination – A variety of recessed volumetric direct/indirect linear fluorescent luminaires shall provide task lighting and ambient room lighting. These lights are most commonly dimmed.
 - .2 Wall Accent Illumination – Recessed linear wall wash luminaires are utilized to illuminate the predominant presentation or graphic display wall.
 - .1 Classroom LC-2501 shall have additional vertical illumination on the adjacent walls provided by recessed square wall washers to accommodate for the lack of daylight in the space.
 - .2 Means of Control:
 - .1 Classrooms shall utilize manual over-ride switches to turn lights ON/OFF while the occupancy sensor shall be programmed to function as a Vacancy sensor.

- .1 Local low voltage switches with dimming capability are installed in these areas to provide manual control of multiple layers of lighting with multiple switch legs.
 - .2 Occupancy sensors shall be programmed for manual ON, and 10-minute time delayed automatic OFF.
- .2 Seminar and Conference Rooms:
 - .1 Means of Illumination:
 - .1 Overhead Ambient/Task Illumination – The primary layer of ambient-task illumination is provided by various recessed volumetric direct/indirect luminaires.
 - .2 Wall Accent Illumination – Recessed linear wall wash luminaires are utilized to provide vertical illuminance where there is a predominant accent or graphic display wall.
 - .2 Means of Control:
 - .1 Seminar and Conference rooms, with the exception of rooms LC-2500 and LC-2600, shall utilize manual over-ride switches to turn lights ON/OFF while the occupancy sensor shall be programmed to function as a Vacancy sensor.
 - .2 Occupancy sensors shall be programmed for manual ON, and 10-minute time delayed automatic OFF.
 - .3 Seminar rooms LC-2500 and LC-2600 shall utilize ceiling mounted occupancy sensors, one located on each side of the dividing partition, to turn fixtures automatically ON/OFF with local switches for manual override.
 - .4 Occupancy sensors shall control only fixtures on the corresponding side of the space.
 - .5 Low voltage switches with dimming capability shall be provided for each zone of each separable room.
- .3 Corridors and Circulation spaces:
 - .1 Means of Illumination:
 - .1 Overhead ambient-task illumination in these areas shall be provided by narrow recessed linear fluorescent luminaires.
 - .2 In some areas, decorative fixtures shall provide visual interest and supplemental illumination.
 - .2 Means of Control:
 - .1 Corridors and Circulation spaces shall be switched ON and OFF via a local ceiling mounted occupancy sensor.
 - .2 The sensor shall be set for auto ON/OFF with a 30-minute time delay off setting.

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 16 – Panelboards.
 - .4 Section 28 46 13 – 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 Consultant, 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 recorded 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 28 46 13 – 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 51 19 – LED Interior Lighting.

1.03 References

- .1 ASHRAE
 - .1 ASHRAE Guideline 0-2005 – The Commissioning Process.
 - .2 ANSI/ASHRAE/IES 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 Division 01.
- .2 Submit sample commissioning forms.

1.05 Closeout Submittals

- .1 Division 01: 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.

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.

1.03 Related Requirements

- .1 Section 26 08 50 – Commissioning of Lighting.
- .2 Section 26 27 26 – Wiring Devices.
- .3 Section 26 51 19 – LED Interior Lighting.

1.04 References

- .1 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 14-13 – Industrial Control Equipment.
 - .4 CSA C22.2 No. 42 - General Use Receptacles.
 - .5 CSA C22.2 No. 42.1 - Cover Plates for Flush Mounted Wiring Devices.
 - .6 CSA C22.2 No. 184 - Solid-State Lighting Controls.
 - .7 CSA C22.2 No. 184.1 - Solid State Dimming Controls.
 - .8 CSA C22.2 No. 156 - Solid-State Speed Controls.
- .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 Division 01.
- .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.

.3 Where the lighting controls include the option for custom engraving, or custom touchscreen user interfaces on control devices, switches, or scene controllers, the Contractor is to submit proposed engraving/labelling/graphics as part of the shop drawing submittal, for review by the Owner.

1.06 Closeout Submittals

.1 Documentation of all lighting control system setpoints, sensor sensitivities, occupancy sensor timeouts, and as-programmed sequences of operation to aid in future troubleshooting.

.2 Lighting controls functional test report.

1.07 Quality Assurance

.1 Manufacturer Qualifications: Products free of defects in material and workmanship.

1.08 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 DLM (Basis of Design).

.2 Acuity Brands Lighting (nLight, Sensorswitch).

.3 Cooper Lighting Solutions.

.4 Current Lighting (formerly Hubbell/GE).

.5 Lutron Vive.

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 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.

2.05 Decorator Low Voltage Momentary Switches

- .1 Wattstopper DCC2 series (Basis of Design).
- .2 Switch intended for use with power packs and sensors requiring a momentary contact switch that provides on/off signals.
- .3 12 VAC/VDC, 24 V Rectified, 24 VAC/VDC
- .4 50 mA Max. Internal Contact rating
- .5 500 mΩ resistance when closed
- .6 Single pole, double throw with centre position rest.

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 51 19, 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 Manufacturers:
 - .1 Lutron NovaT* style dimmers.
 - .2 Cooper
 - .3 Leviton.
 - .4 Approved Equal.

2.07 Sequences of Operation

- .1 To Section 26 06 50.19.

- .2 In accordance with ASHRAE 90.1-2013.

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 System Startup

- .1 The lighting controls manufacturer's representative shall conduct system startup and submit startup report.

3.03 Site Tests and Inspections

- .1 The lighting controls manufacturer's representative and Contractor shall conduct functional testing and provide report as described in ASHRAE 90.1-2013:
 - .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 Occupant Sensors
 - .1 Certify that the sensor has been located and aimed in accordance with manufacturer recommendations.
 - .2 For projects with up to seven (7) occupancy sensors, all occupancy sensors shall be tested.
 - .3 For projects with more than seven (7) occupancy sensors, testing shall be done for each unique combination of sensor type and space geometry.
 - .4 For each sensor to be tested, verify the following:

- .1 Status indicator (as applicable) operates correctly.
 - .2 Controlled lights turn off or dim down to the specified level within the required time (20 minutes, or as noted), as applicable to the space type.
 - .3 For auto-on occupant sensors (occupancy mode), the lights turn on to the permitted level when someone enters the space.
 - .4 For manual-on sensors (vacancy mode), the lights turn on only when manually activated.
 - .5 The lights are not incorrectly turned on by movement in nearby areas or by HVAC operation.
- .3 The individual(s) responsible for the functional testing shall not be directly involved in either the design or construction of the project and shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.
 - .2 Test lighting controls with fire alarm system in accordance with Section 28 08 46 and Section 28 46 51.
 - .3 Commissioning:
 - .1 Submit commissioning report to the Consultant and the commissioning authority for review.

3.04 Training

- .1 Provide training session of minimum 4 hours duration in accordance with Division 01.

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.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 5:16 (R2021), Molded Case Circuit Breakers, molded-case switches, and circuit-breaker enclosures.
 - .4 CSA C22.2 No. 29-15 (R2024), Panelboards and Enclosed Panelboards.
 - .5 [CSA C22.2 No. 269.2-17 (R2022), Surge Protective Devices - Type 2 - Permanently Connected.]
- .2 NEMA:
 - .1 NEMA ICS 2-2000 (R2020) – Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 volts.
 - .2 NEMA KS 1-2013 – Heavy Duty Enclosed and Dead-Front Switches (600 volts Maximum).
 - .3 NEMA PB 1-2011 – Panelboards.
 - .4 NEMA PB 1.1-2013 – General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 volts or Less.
- .3 NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.04 Submittals

- .1 Submit in accordance with Division 01.
- .2 Work of this Section is to be submitted for review after Consultant's review of Coordination Study per Section 26 05 73.16 is completed.
- .3 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.
- .4 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 Consultant:
 - .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 Consultant:
 - .1 Key interlock scheme drawing and sequence of operations.
- .5 Submittals for Construction
 - .1 The following information shall be submitted for record purposes:
 - .1 Installation information.

1.05 Closeout Submittals

- .1 Refer to Division 01.
- .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 Company specializing in manufacturing of panelboard products with a minimum of 20 years' experience.
 - .2 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
 - .3 For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
 - .4 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Consultant, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

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 Warranty

- .1 Warrant specified equipment to be free from defects in materials and workmanship for eighteen (18) months from the date of purchase.

2 Products

2.01 General

- .1 Description: CSA C22.2 No. 29, circuit breaker type.

2.02 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 V 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 A frame and through 100 A 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 A symmetrical at 240 V, and 14 000 amperes symmetrical at 480 V, 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 Panels shall be dead front type in code gauge steel enclosures. All panels shall be sprinkler proof c/w drip hoods as required.
- .27 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.
- .28 Where panels exceed 42 circuits, use multi-section panel with main cross-over solid bus bars unless noted otherwise on drawings. Main bus capacity of each section shall be full size to match cross-over bus.
- .29 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.
- .30 Panels for 120/208 V, 3-phase, 4-wire systems shall be complete with full size breakers.
- .31 Where shown on drawings or required by code, certain breakers shall include ground fault interrupter.
- .32 Provide lighting and receptacle panels suitable for surface, or flush-mounting type, as shown.
- .33 Provide locking bars on non-switched circuits where panels are used for switching lighting circuits.
- .34 Panels for non-linear loads shall be complete with lugs for double neutrals.
- .35 Panels shall be given a rust-resistant treatment to both tub and trim.
- .36 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.
- .37 Surface mounted panels shall have manufacturer's standard surface door trim complete with lock and latch. Finish shall be grey.
- .38 Recessed panels shall have standard flush trims.

- .39 Co-ordinate panel finish with Room Finish Schedule.

2.03 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.

2.04 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 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.

2.05 Bus

- .1 Lugs: Copper and listed by CSA, or cUL, for use with copper conductors and sized to accept copper conductors of the ampacity specified.
- .2 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°C above an ambient of 40°C maximum.
- .3 A copper system ground bus shall be included in all panelboards.

- .4 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.

2.06 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.

2.07 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 26 05 29. 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 the 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.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 14-18 (R2022), 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 (R2022), Cover plates for flush-mounted wiring devices.
 - .6 CSA C22.2 No. 55:15 (R2020), Special use switches.
 - .7 CSA C22.2 No.111-18 (R2023), General-use snap switches.
 - .8 CSA C22.2 No. 182.1:17 (R2021), Plugs, receptacles, and cable connectors of the pin and sleeve type.
 - .9 [CSA Z32:21, Electrical safety and essential electrical systems in health care facilities.]

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 A, 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 V or 347 V, AC as indicated.
- .6 Current: 20 A.
- .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 V:
 - .1 Hubbell HBL2121 series.
 - .2 347 V:
 - .1 Pass & Seymour 2601-347 series.
- .10 Example Products (Toggle style):
 - .1 120 V:
 - .1 Hubbell HBL1221 (single pole).
 - .2 Hubbell HBL1222 (double pole).
 - .3 Hubbell HBL1223 (three-way).
 - .4 Hubbell HBL1224 (four-way).
 - .2 347 V:
 - .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 A, 120 V, single phase grounded duplex receptacle shall be NEMA-U- ground type CSA Configuration 5-15R.
 - .2 20 A, 120 V, single phase grounded duplex receptacle shall be NEMA-U-ground type CSA Configuration 5-20RA
 - .3 15 A, 120 V, 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 (5 ft) 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 (15 A 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 (15 A duplex decorator style).
 - .2 Hubbell BR20WHITR (20 A duplex decorator style).
- .12 USB Charger receptacles: duplex tamper resistant device.
 - .1 USB ports: one type A and one type C USB charging port, 5 A, 5 V.
 - .2 Example: Hubbell USB15AC5WWR.

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 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.
- .9 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 2021 OESC rule 26-708.
 - .1 Weatherproof Cover Plate: Ultra-rugged polycarbonate and synthetic neoprene rubber:
 - .1 Hubbell ML500GCN series (single-gang):
 - .1 low profile design which expands from 25 mm (1 in) to 75 mm (3 in) for weatherproof protection while an outlet is in use while maintaining the "Extra Duty" ratings.
 - .2 Clear window allows for quick/easy visual inspection.
 - .3 All required gasket and mounting hardware.
 - .4 Pre-configured for GFCI type receptacles.
 - .5 Complete with gaskets to accommodate duplex receptacles or Data outlets.
 - .6 NEMA 3R compliant.
 - .7 Colour: Gray.
 - .2 Hubbell ML2450GCN series (2-gang):
 - .1 low profile design which expands from 25 mm (1 in) to 75 mm (3 in) for weatherproof protection while an outlet is in use while maintaining the "Extra Duty" ratings.
 - .2 Clear window allows for quick/easy visual inspection.
 - .3 All required gasket and mounting hardware.
 - .4 Pre-configured for GFCI type receptacles.
 - .5 Complete with gaskets to accommodate quadplex receptacles or Data outlets.
 - .6 NEMA 3R compliant.
 - .7 Colour: Gray.

2.05 Special Wiring Devices

- .1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel flush type.

2.06 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 Receptacles to be white for devices connected to normal power circuits, red for devices connected to essential power circuits including isolated power centres. Isolated ground receptacles connected to circuits fed from uninterruptible power supply units to be orange colour. Generally, install receptacles in Patient Care Areas vertically with ground pins up.
- .5 Safety shutter type receptacles to be located where shown and required by code and CSA Z32.
- .6 In patient care areas, 15 A/20 A straight blade receptacles to be hospital grade.
- .7 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 in) above finished roof level, complete with wet location "while in use" "extra duty" cover plate.
 - .2 Locate within 7500 mm (25 ft) of new HVAC equipment, and at least 2000 mm (6.5 ft) away from roof line.
 - .3 Refer to 2021 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 References

- .1 CSA C22.2 No. 248 series.

1.02 Submittals

- .1 Provide submittals in accordance with Division 01.
- .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 Division 01.

1.03 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 Division 01.

1.04 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 1-600 A or Class-L for 650 A and above.
- .5 Provide the following accessories where indicated or where required to complete installation:
 - .1 Fuseholders: Compatible with indicated fuses.

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 914 mm by 914 mm by 305 mm (3 ft by 3 ft by 1 ft).

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 Molded-case circuit breakers.
- .2 Molded-case switches.
- .3 Accessories.

1.02 Related Requirements

- .1 Section 26 01 20.24 – Circuit Breaker Retrofit in Switchboards.
- .2 Section 26 24 16 – Panelboards.

1.03 References

- .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (28th edition/2021).
- .3 CSA C22.2 No. 5-16 (R2021), Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
- .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 Division 01.
- .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 Consultant for review.
 - .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 the Consultant. Unless complying with this requirement, Consultant 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 Section 26 24 16.

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 224 Ampere

- .1 Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.

2.06 Molded Case Circuit Breakers – 225 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.

2.08 Molded-Case Switches

.1 Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

.2 Accessories:

.1 Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.

.2 Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.

2.09 Enclosed Breakers and Enclosed Molded-Case Switches

.1 Molded case, front operated, automatic circuit breakers sized as specified on drawings each secured in a NEMA 1, flush wall mounting enclosure with steel front panel.

.2 Voltage rating suitable for circuit phase to phase voltage as indicated on drawings.

.3 Units to include solid state adjustable trip units and contactors. Contactors to be of rating and type to suit application.

2.10 Circuit Breakers for Existing Distribution Equipmen

.1 Products to be of types from existing equipment manufacturers.

.2 Additional breakers for existing panelboards are to match existing device standards and be completely compatible to equipment in which they are installed.

.3 During Bidding period, check and verify exact requirements of existing equipment to ensure that additional devices are accommodated.

.4 Make necessary modifications to equipment to accommodate device and feeder installation.

.5 Provide suitable engraved lamacoid identification nameplate on additional components.

.6 Revise typed circuit directory cards on branch circuit panelboards.

.7 Mount additional devices to standards of existing equipment manufacturer.

.8 Refer to notes on drawings.

.9 Provide additional retrofit work to existing equipment as noted on drawings.

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 amps to 800 amps.

1.02 Related Requirements

- .1 Section 26 28 13 – Fuses.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 4:16 (R2020), 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 Provide disconnect switches for connection to equipment as described in Section 26 05 83.
- .5 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 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.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 250.0 - Luminaires (Bi-National Standard, with UL 1598).
- .2 DesignLights Consortium (DLC):
 - .1 Solid-State Lighting Technical Requirements v5.1, 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 IES TM-21-11 – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.
 - .5 IES TM-30-15 – IES Method for Evaluating Light Source Color Rendition.
- .5 IEEE 1789-2015 – IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers.
- .6 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 Division 01.
- .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 Division 01: Submittals for project closeout.
- .2 Submit manufacturer's operation and maintenance instructions for each product.
- .3 Warranty information.

1.08 Qualifications

- .1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.09 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.

1.10 Delivery, Storage, and Handling

- .1 Deliver, store and handle materials in accordance with Division 01.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.11 Extra Stock Materials

- .1 Refer to Division 01.
- .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.

1.12 Warranty

- .1 Refer to Division 01 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 Manufacturers

- .1 As noted on Lighting Fixture Schedule.

2.02 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 IES LM-79 and IES LM-80, and include published L70 data.
- .4 Colour rendition:

- .1 Interior luminaires with a CRI greater than or equal to [80] [90], or as indicated on the lighting fixture schedule.
- .2 Where minimum 90 CRI is indicated, the following may be considered acceptable in lieu, subject to confirmation with the Consultant by means of a Request for Interpretation during the bid period:
 - .1 CRI (Ra) $\geq$ 90.
 - .2 CRI (Ra) $\geq$ 80 and R9 (R9) $\geq$ 50.
 - .3 IES Rf $\geq$ 78, IES Rg $\geq$ 100, $-1\% \leq$ IES Rcs, h1 $\leq$ 15%.
- .5 Correlated colour temperature as indicated on the lighting fixture schedule.
- .6 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.
- .7 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.
- .8 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.
- .9 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.

.10 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.

.11 Control of Visual Perceptions of Temporal Light Modulation (flicker):

- .1 All electric lights (except decorative lights, emergency lights and other special-purpose lighting) used in regularly occupied spaces meet at least one of the following requirements for flicker:
 - .1 A minimum frequency of 90 Hz at all 10% intervals from 10% to 100% light output.
 - .2 LED products with a "low risk" level of flicker (light modulation) of less than 5%, especially below 90 Hz operation as defined by IEEE standard 1789-2015 LED.

2.03 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) $\pm 10\%$ or (347-480) $\pm 10\%$.
 - .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°C through $+80^{\circ}\text{C}$.
- .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.

2.04 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): as indicated on the lighting fixture schedule.
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.05 Nominal 305 mm by 1220 mm (1 ft by 4 ft) 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): as indicated on the lighting fixture schedule.
- .6 Colour Rendition Index (CRI): 80 CRI minimum.
- .7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.06 Nominal 610 mm by 1220 mm (2 ft by 4 ft) 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): as indicated on the lighting fixture schedule.
- .6 Colour Rendition Index (CRI): 80 CRI minimum.
- .7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES 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 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 For luminaires with field selectable lumen output and/or CCT, ensure the correct setting matches the intended set points.
- .3 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.
- .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.

3.04 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 Use SPC90 conductors for final connections to luminaires (including 0-10 V dimming conductors for applicable luminaires).
- .2 Install luminaire disconnect plugs on all new luminaires not provided as such from the manufacturer.
- .3 Connect luminaires to branch circuit outlets provided under Section 26 05 33.13 using flexible conduit.
- .4 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .5 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 Section Includes

- .1 Provide a complete system of conduits, pull boxes, outlets, sleeves, and all components for a complete working system.
- .2 Existing PA System is Carehawk.

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 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (28th edition/2021).
- .3 CAN/CSA-C22 No. 214 M90 Communications Cables.
- .4 CAN/CSA-T530 Commercial Building Standards for Telecommunications Pathways and Spaces.
- .5 CAN/CSA-T529-95 Commercial Buildings Telecommunications Standards.
- .6 CAN/CSA-T527 Grounding and Bonding Requirements for Telecommunications in Commercial Buildings.
- .7 CAN/CSA-T528 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- .8 Ontario Building Code.

1.04 Submittals

- .1 Product Data.

2 Products

2.01 Outlet Boxes

- .1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.

2.02 Conduit

- .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 (3/4") diameter.
- .3 Plywood backboards shall be minimum 1200 x 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.

2.03 Cabling

- .1 Provide twisted pair shielded cabling by Belden to building standard for each device.
- .2 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations for cable installation.

2.04 Equipment

- .1 Handset: Dukane model PCS821, black cyclac, dynamic transmitter, standard magnetic receiver, 6'(1.8m) coiled cord, c/w two-gang stainless steel face plate, chromed steel two-pole hookswitch/cradle, rocker (PVCY and CALL) switch, and standard two-gang electrical back box.
- .2 Speakers: McBride series 8224 (recess mounted in Modular Control Panel (MCP)), pre-assembled "call-in" speaker complete with 8" dual cone speaker with magnet, 12.5" square steel baffle (MC25A), 24 or 70 Volt to match existing, 4 watt transformer and suitable back box.

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 30 000 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. Include above noted information on final record drawings at project completion.
- .6 Install new devices within ceiling or on wall as noted on the drawings.

3.02 Terminations

- .1 Connections at main PA rack will be by Electrical Contractor.

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. Ensure that the systems specified hereafter are complete and operative.

1.04 Specifications Language and Style

- .1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to Contractor, unless stated otherwise.
- .2 Complete sentences by reading "shall", "Contractor shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.
- .3 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.
- .4 When used in the context of a Product, read the word "provide" to mean "supply and install to result in a complete installation ready for its intended use."

1.05 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 BICSI G1-17 – Outside Plant Manual.
- .3 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

- .2 Ontario Electrical Safety Code (28th edition/2021).
- .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.

1.06 Submittals

- .1 Before delivery to site of any item of equipment, submit shop drawings c/w all data, pre-checked and stamped accordingly, for review to the Consultant. Indicate project name on each brochure or sheet. Submit shop drawings within 1 week after award of contract.

1.07 Record Documentation

- .1 To Division 01.
- .2 Red lines, mark-ups by this contractor.

1.08 Operation and Maintenance Manuals

- .1 Refer to Division 01.

1.09 Inspections

- .1 The Consultant will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.

1.10 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.

1.11 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.

1.12 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 provide 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.

1.13 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.

1.14 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.

1.15 Warranty

- .1 Submit a written performance warranty to the Owner for one year for the complete installation for a period of no less than five years from the date of testing and acceptance. The system warranty shall be based on industry standards.
- .2 The contractor shall also provide a one year 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 demonstration the proper operation of all miscellaneous systems.

End of Section

1 General

1.01 Summary

- .1 Section Includes:
 - .1 Demolition and removal of selected portions of building or structure.
 - .2 Demolition and removal of selected site elements and/or Information Technology (IT), Security or other special systems or infrastructure.
 - .3 Salvage of existing items to be reused or recycled.
- .2 Contractor shall include in the Bid all labour, materials, tools, plant, transportation, storage costs, equipment, insurance, temporary protection, permits, inspections, taxes, and all necessary and related items required to provide complete demolition and cutover of existing telecommunication systems shown and described in the Specifications.
- .3 The Contractor is responsible for providing and coordinating phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.
- .4 The Contractor shall coordinate interfaces to existing systems that are being demolished in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with Owner.
- .5 The Contractor shall coordinate specialty electronic, IT data networks, common use, CCTV, public address, and any other IT infrastructure systems.

1.02 Related Requirements

- .1 Division 02 – Existing Conditions.

1.03 Definitions

- .1 Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- .2 Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- .3 Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- .4 Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.04 Administrative Requirements

- .1 Pre-Demolition Meeting
 - .1 Conduct a pre-demolition meeting at Project Site with Owner and all affected stakeholders.
 - .1 Inspect and discuss condition of construction to be selectively demolished.
 - .2 Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

- .3 Existing telecommunications rooms that have demolition work may involve electrical, mechanical, and architectural demolition. Review and coordinate requirements of work performed by other trades.
- .4 Review areas where existing construction is to remain and requires protection.
- .5 Review procedures to be followed when critical systems are inadvertently interrupted.

1.05 Submittals

- .1 Action Submittals
 - .1 Comply with all submittal procedures given in other Sections.
 - .2 Submit a Schedule of selective demolition and cutover activities which indicates the following as a minimum:
 - .1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's and tenants' on-site operations are uninterrupted.
 - .2 Duration of how long IT and security services will be interrupted and when systems cannot be disabled and temporary parallel service is required submit how this is proposed to be accomplished.
 - .3 The contractor's plan for coordination of shutoff, capping, and continuation of IT and all other utility services.
 - .4 Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 - .3 Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
 - .4 Pre-demolition Photographs or Video: Submit before Work begins.
 - .5 Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.
- .2 Closeout Submittals
 - .1 Submit a list of items that have been removed and salvaged.
 - .2 Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
 - .3 Submit as-built documentation of all remaining IT and security systems conduit and cabling that remains.

1.06 Material Ownership

- .1 Unless otherwise indicated, demolition waste becomes property of Contractor.

1.07 Field/Site Conditions

- .1 Owner will occupy portions of building immediately adjacent to selective demolition area.
 - .1 Conduct selective demolition so Owner's operations will not be disrupted.

- .2 Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - .1 Before selective demolition, Owner will remove their equipment from the space.
- .3 Notify Consultant of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- .4 Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - .1 Hazardous materials will be removed by Owner before start of the Work.
 - .2 If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer. Hazardous materials will be removed by Owner under a separate contract.
- .5 Storage or sale of removed items or materials on-site is not permitted.
- .6 Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.08 Warranty

- .1 Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

2 Products – Not Used

3 Execution

3.01 Examination

- .1 Verify that utilities have been disconnected and capped per Owner approved procedures before starting selective demolition operations.
- .2 Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- .3 Survey existing condition of all IT related conduits and cables from origin to destination and correlate with requirements indicated to determine extent of selective demolition required.
- .4 Label all conduits and cables with origin, destination and what system they serve.
- .5 Consult with Owner to determine whether systems can be disabled or whether a new parallel system needs to be installed.

3.02 Removal of Communications Cabling and Equipment

- .1 Demolish and remove existing construction only to the extent required by new construction and as 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. Remove all abandoned cables from origin to destination.
 - .2 Dispose of demolished items and materials promptly.

- .2 Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- .3 For existing equipment cabinets with active components in them, provide an airtight dust seal around the cabinet and circulate cooling air with a portable air conditioning unit or other means to ensure equipment does not overheat.
- .4 If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
- .5 When removing communications outlets, remove all conductors back to patch panel in communications closet or IT rack. Provide blank faceplates where outlets are removed from walls or partitions to remain.
- .6 Where communications cabling is to be re-used, coil the communications outlet cabling in the ceiling space for re-use.
- .7 Turn over wireless access points to Owner.

3.03 Disposal of Demolished Materials

- .1 General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in accordance with the requirements of the Authority Having Jurisdiction.
 - .1 Do not allow demolished materials to accumulate on-site.
 - .2 Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - .3 Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- .2 Burning: Do not burn demolished materials.
- .3 Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.04 Cleaning

- .1 Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

End of Section

1 General

1.01 Summary

- .1 Provide a complete system of empty conduit, pull boxes, outlets, and sleeves for enclosure of 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 BISC Telecommunications Distribution Methods Manual, 14th Edition.

1.04 Closeout Submittals

- .1 Record documentation:
 - .1 Records of underground utility locates.
 - .2 Record as-constructed location of all underground conduits and telecommunications pathways on as-built drawings regardless of conduit size.

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.

- .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 3.2 mm (1/8") 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 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. Include above noted information on final record drawings at project completion.

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, add-ons 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 7 mm (0.27 in) 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 Division 01.
- .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:

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- .1 Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

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 Substitutions: as approved by the Consultant prior to tender closing.
- .3 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.

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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.

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 Inspections: Engage qualified independent inspection agency to inspect through-penetration firestop systems.
- .2 Keep areas of work accessible until inspection by authorities having jurisdiction.
- .3 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 Section Includes

- .1 Labelling and identification requirements for communications systems.

1.02 References

- .1 ANSI/TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure.
- .2 UL 969 – Marking and Labeling Systems.

2 Products

2.01 Summary

- .1 Adhesive cable labels to meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition, the labels shall meet the general exposure requirements in UL 969 for indoor use.
- .2 Self-laminating vinyl construction cable labels with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.
- .3 ANSI/EIA/TIA-606 for colour codes shall be followed. Labels are to be mechanically printed using a laser printer. Hand written labels will not acceptable.

2.02 Label Printer

- .1 Thermal Transfer Printer shall print high quality, industrial labels on a wide variety of materials for electrical and network applications such as wire/cable, components, safety, and facility identification.
- .2 Laminated Adhesive Label Cassettes:
 - .1 For flat label applications.
 - .2 Polyester material.
- .3 Non-Laminated Adhesive Label Cassettes:
 - .1 For marking wire and cable and flat label applications.
 - .2 Polyester material
- .4 Example Products:
 - .1 Panduit LS7 series hand-held printer.
 - .2 Panduit LS8 series hand-held printer.

2.03 Nameplates

- .1 Engraved three-layer laminated plastic, letters on contrasting background:
- .2 Rack and Cabinet ID labels: 25 mm (1") high White Text on Black Background

3 Execution

3.01 Installation

- .1 Cable identification labels should appear at the following locations with the numbers indicated on the cable schedule and drawings:
 - .1 300 mm (12 inches) from each end of the cable – after termination.
 - .2 Front of patch panels.
 - .3 Front of IDC termination blocks.
 - .4 Front of workstation/communications outlet faceplates.
 - .5 Each end of each Telecommunications Conduit.
- .2 Fibre Optic safety labels shall appear at the following locations:
 - .1 Along the length of the conduit or innerduct at 3 m (10 foot) intervals.
 - .2 At all junction boxes
 - .3 At all pull boxes.
 - .4 On all fibre optic patch panels.
- .3 Provide 25 per cent additional labels to be left in each telecommunications room on site for future growth.
- .4 Provide two Rack/Cabinet nameplates. Mount one on the front, and one on the rear of the rack.

3.02 Identification Conventions

- .1 All cabling will be labelled with the closet letter, followed by a dash and the wire number (i.e. A-001 would be the first wire in closet A).
- .2 Labelling for backbone wiring will be preceded with BB followed by the wire number (i.e. BB-001 would be the first backbone).

End of Section

1 General

1.01 Section Includes

- .1 Commissioning Requirements.

1.02 References

- .1 Refer to Section 27 05 00 for references.

1.03 Closeout Submittals

- .1 The Telecommunications Cabling Contractor is required to submit test results in native tester format or a format which can be read with a text reader (i.e. ".txt" extension). Paper results shall not be submitted for projects with 100 or more horizontal cable drops and/or fibre cables.
- .2 The Telecommunications Cabling Contractor is required to provide the software required to view the results.
- .3 The report should be divided into sections by Telecommunications Room.
- .4 The report should indicate for each cable when it was tested successfully, the result, and the length.
- .5 The Telecommunications Cabling Contractor shall sign off on the entire test report prior to submitting to the Consultant.
- .6 The test result documentation is to be submitted to the Consultant for review no later than 10 working days following the completion of the installation.
- .7 All deficiencies must be corrected before the Consultant will provide a certificate to release the Holdback on the project.

2 Products – Not Used

3 Execution

3.01 Installation

- .1 Testing of all horizontal copper cables are to be completed in accordance with the follow test criteria:
 - .1 Basic Link
 - .2 Grounds
 - .3 NEXT
 - .4 ELFEXT
 - .5 Continuity
 - .6 correct polarity
 - .7 PSNEXT
 - .8 PSELFEXT
 - .9 Shorts

- .10 Length
- .11 ACR
- .12 Return Loss
- .13 Opens
- .14 Attenuation
- .15 PSACR
- .16 Resistance
- .2 Fibre strands in excess of 122 m (400 ft) shall be tested with an Optical Time Domain Reflectometer for length and attenuation.
- .3 Test each stand of fibre, bi-directionally, with a Power Meter / Light Source combination operating at wavelengths of 850 nm and 1300 nm for multimode fibres.
- .4 Maximum multi-mode passive link loss (including patch cords) is not to exceed -2.35 dB.
- .5 Maximum single-mode passive link loss (including patch cords) is not to exceed -1.0 dB.

3.02 Record Drawings

- .1 The Telecommunications Cabling Contractor is required to maintain one set of correct and accurate record drawings on-site at all times. These drawings are to be made available to the General Contractor/Construction Manager or the Consultant for review during the project.
- .2 The Telecommunications Cabling Contractor is required to provide record drawings of the telecommunication cabling installation in relation to the drawings provided in this specification.
- .3 The record drawings shall be updated electronically and include, but are not limited to;
 - .1 Horizontal cable numbers on the floor plans
 - .2 Horizontal Cable Routing on the floor plans
 - .3 Changes on the floor plans
 - .4 Backbone cable Routing between Telecommunications Rooms
 - .5 Paging Speaker Locations including daisy chain cable run
 - .6 Wireless Access Points and Cell coverage
 - .7 Cabinet/Rack Elevation drawings
 - .8 Backboard Elevation Drawing
- .4 The Telecommunications Cabling Contractor shall provide one soft copy in AutoCAD 2007 and one plotted copy for the Consultant to review prior to complete substantial performance and close-out documentation submission.
- .5 After approval, the Telecommunications Cabling Contractor shall submit one plotted copy of the drawings for;
 - .1 The Main Computer Room

- .2 Each Telecommunications Room
- .6 All close-out documentation must be submitted to the General Contractor/Construction Manager or The Consultant within 10 working days of the completion of the project before the documentation holdback will be released.

End of Section

1 General

1.01 Summary

- .1 Supply, install and test complete data cabling system and accessories, based on physical star wiring topology, and as specified herein and indicated on drawings.
- .2 Include data cabling system the following sub-systems:
 - .1 Backbone Terminal Systems, located in Communications Closets, to serve as connection points between backbone cables and horizontal distribution cables.
 - .2 Horizontal distribution system links backbone terminal system to telecommunications outlets.
 - .3 Contractor is to submit details on equipment types and locations for review and approval prior to installation.

1.02 Related Requirements

- .1 Active electronics, including servers, hubs, routers, switchers, and, PCs are by Owner and are not part of this contract.

1.03 Abbreviations and Acronyms

- .1 MTER Main Telecommunication Equipment Room.
- .2 TC Telecommunications Closet.
- .3 TCs Telecommunications Closets.
- .4 RCDD Registered Communications Distribution Designer.
- .5 BICSI Building Industry Consulting Service International.
- .6 MDTS Main Distribution Terminal System.
- .7 IDC Insulation Displacement Connection.
- .8 OTDR Optical Time-Domain Reflectometer.
- .9 BCS Backbone Cabling System.
- .10 IDT Intermediate Distribution Terminal.
- .11 BTS Backbone Terminal System.

1.04 Reference Standards

- .1 Conform to CAN/CSA-T530 for new buildings and areas of substantial renovations of telecommunications, spaces, and pathways.
- .2 Ensure that cabling system shall conform to current issue of industry standard CAN/CSA-T529. This standard is currently being revised and is available as document EIA/TIA SP-2840A (future CAN/CSA-T529). All requirements of this new document must be followed including: Structural Return Loss (section 10.2.4.5), Power Sum Testing (section 10.3.4.7) and End to End Link Performance and continuity, attenuation, cable open and shorts, NEXT; mutual capacitance, pair polarity and cable impedance, S/N ratio, and Pass/Fail status. Tests are to be conducted and recorded using a Penta Scanner. Fibre optic cables shall be tested in conformance to ISO/IEC IS 11801 standards using an EXFO Optical Time

Domain Reflectometer. Test results such as; dB loss, cable length and fibre deficiencies (if any) shall be conducted. Verification, documentation, and warranty shall be provided.

- .3 Where applicable, have performance of Category 5e cabling components used, verified by nationally recognized testing laboratory. Submit test results upon request.
- .4 Conform to applicable Building and Electrical Safety Codes.

1.05 Submittals

- .1 Shop Drawings
 - .1 Provide submittals in accordance with Division 01 prior to commencing installation.
 - .2 Submit complete cabling system layout for Consultant review for data, cable routing summary and cable outlet designation. Have cabling system layout performed by accredited RCDD (Registered Communications Distribution Designer) as defined by BICSI (Building Industry Consulting Service International). The Data Cabling system will not be accepted without this submission.
 - .3 Documentation proving compliance to End-to-End Link Performance test, as specified in Annex E of EIA/TIA SP-2840A shall be provided prior to structured cabling being installed.
 - .4 Submit detailed layout drawings, including termination racks prior to commencing this installation.
 - .5 Manufacturer's product information documents on all components of the cabling system, including horizontal and vertical cable management systems and all auxiliary components/devices and equipment prior to commencing this installation.
 - .6 The following documentation shall be submitted with a following cover letter listing attachments prior to commencement of work.
 - .1 A list of personnel for the project that will include the name of the Project Manager, Site Manager(s), Lead Hands, and Installers.
 - .2 Permits and notifications as may be required for the project.

1.06 Closeout Submittals

- .1 Provide manufacturer's certificate at completion of installation certifying the installation.
- .2 Prepare and submit "As-built" drawings reviewed by an RCDD.
- .3 "As-built" drawings are to detail the exact location of equipment indicating wiring runs and raceways, pull, junction and terminal boxes. Also to include outlet locations, cable numbers and equipment rack profiles.
- .4 Upon completion of work and prior to final acceptance, the contractor will submit to the Owner the required copies of Network Certification and Documentation in the form of manuals that will include the following:
 - .1 Detailed information on types of materials and equipment used and their locations including: distribution frame equipment (rack), equipment types and locations; a detailed listing of cable and outlet types and locations.
 - .2 Accurately and neatly recorded test results.
 - .3 Accurately and neatly record locations including room numbers, of all network components in list form for easy reference.

- .4 Identify drawings as 'Project Record Copy' and maintain in new condition making available for inspection by Owner.
- .5 Bind all items listed above in a 3-ring hard covered binder suitably labelled with the names of each site/project.

1.07 Quality Assurance

- .1 Qualifications of Manufacturer
 - .1 Supply equipment manufactured by experienced reputable manufacturer, whose installations have rendered satisfactory service for at least 2 years and who would provide factory trained technicians fully experienced in telecommunications wiring. Submit information regarding number of employees, and proof of VAR/CSV certification, including length of time Contractor or employee(s) have been certified to install Cable systems.
 - .2 Provide certification that cabling solution offered will perform as a system as is defined in standards documents such as EIA-TIA SP-2840A and T568A configuration for Category 5E system standards. Provide certification supported by manufacturer of cabling components used.
 - .3 In addition to certificate of assurance, evidence of support by manufacturer for above items shall be provided upon request in writing with bidding response.
 - .4 Use components sourced completely from single manufacturer.
- .2 Qualifications of Installer
 - .1 Provide installation and supervision work supervised by telecommunications technicians qualified to install voice and data cabling system and to perform related tests as required by manufacturer. Installers/company must have valid certification.
 - .2 Provide fully qualified telecommunications technicians, trained and certified by manufacturer in installation and testing of equipment specified. Provide evidence upon request in writing prior to work commencement of manufacturer's certification of supplier's ability to properly install structured cabling for building.
 - .3 Submit proven track record in cabling projects of similar size. Include details of minimum 3 projects of similar size involving category 5E cabling, Multimode and Single-mode fibre optic cabling which have been completed in last 2 years. Include names, addresses, and phone numbers of references for 3 projects.
- .3 Certifications
 - .1 UTP network wiring shall conform to T568A configuration, Category 5e system standards. All UTP cables shall provide minimum signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination at each end. The following tests will be conducted and recorded using a Penta Scanner:
 - .2 End to end continuity, attenuation, cable open and shorts; NEXT; mutual capacitance; pair polarity and cable impedance; S/N ratio and pass/fail status.

1.08 Warranty

- .1 The structured cabling systems shall be warranted for 25 years, covering all system products manufactured and provided by the single source supplier. The warrantor shall guarantee the following:
 - .1 All passive system components, e.g. patch panels, UTP cable and outlet jacks are free from manufacturing defects in material or workmanship

- .2 Approved cabling systems exceed the specifications of the T1A-568A standards and ISO/IEC IS 11801, if applicable.
- .3 The installation exceeds attenuation and near end cross talk, loss and bandwidth requirements TIA Bulletin TIA TSB-67 and ISO/EIC IS 11801.
- .2 General workmanship and apparatus installed under this contract shall be warranted against defects of workmanship and material for a period of one year after final acceptance of work by the Owner, unless otherwise specified. The contractor will make good any defects developed as a result of their work during such time without expense to the Owner.

2 Products

2.01 Manufacturers

- .1 Manufacturer List
 - .1 Belden.
 - .2 Commscope.
 - .3 Panduit.
- .2 Substitution Limitations
 - .1 Copper cabling installation shall be of one manufacturer.

2.02 UTP Cabling

- .1 100 ohm 4 pair UTP, compliant with TIA/EIA-568-C.2
- .2 Category 3 cabling for telephone communication.
- .3 Category 6 for data communication, security cameras.
 - .1 Unshielded twisted pair, 4 pair twisted, #24AWG, FT-6/CMP plenum rated, blue outer insulation,
- .4 CMP (FT6) Plenum rated.
- .5 No splicing of any data network cabling will be permitted.

2.03 Data Outlets

- .1 All data jacks must meet specifications.
- .2 Computer outlets complete with termination jacks shall be single, duplex or quad flush faceplates complete with Category 5e, 8-position jacks.
- .3 Supply and install one – 4 pair cable to the single outlet, two – 4 pair cables to the duplex outlet, and three – 4 pair cables to quad outlet.

2.04 Patch Panels/Equipment Racks

- .1 All data UTP, 4 pair, Category 6 horizontal cables are to be terminated on cabinet or rack mounted 24/48 port panels wired.
 - .1 PS5 HD-BIX Patch panel, 1U, 24 Port (Belden AX100465 or equal)

- .2 PS5 HD-BIX Patch panel, 2U, 48 Port (Belden AX100473 or equal)
- .2 Network rack must have the following features:
 - .1 Free standing.
 - .2 Standard 19" module compatible.
 - .3 Lockable door.
 - .4 Maximum dimensions of 22"w x 36"d x 85" h.
 - .5 Acceptable products:
 - .1 RF Mote Cat. #RFM-1944-RHD c/w hinged lockable door.
 - .2 Anixter Cat. #175419 c/w hinged lockable door.
- .3 Distribution panels must be category 6 rated BIX punchdown style with capacities as follows;
 - .1 24 port Belden AX100465
 - .2 48 port Belden AX100473
 - .3 96 port Belden AX100485
- .4 In addition to the above, provide all necessary ancillary equipment such as cable management, label holders, and patch cords.

2.05 Patch Cords

- .1 Provide Category 6 patch cords, consisting of 4 pair stranded cable rated FT4 or higher and stamped accordingly. They must conform to EIA/TIA 568A and meet or exceed the EIA/TIA TSB-36 specifications for cordage.
- .2 Patch cords at the workstation end shall be 3050 mm in length, one per data cable.
- .3 Patch cords at the TC end shall be 2133 mm in length, one per data cable.

3 Execution

3.01 Pathways for Communications

- .1 Conduit to Section 26 05 33.13. J-Hooks: as described in Section 27 05 29.
- .2 Cabling between cable tray/j-hooks and data outlets to be enclosed in EMT conduit.
- .3 Cables/data outlets may be enclosed in pre-finished non-metallic raceways computer labs, classrooms, etc. where indicated.
- .4 Data network cables shall be installed in cable tray. Data network cables shall not be tie-wrapped to electrical conduits, mechanical piping, etc. and shall be run as far as possible from fluorescent lighting fixtures, transformers and electrical power service conduits.

3.02 Installation

- .1 Each equipment rack shall be anchored securely to the floor and grounded to the building ground with a #6 AWG Insulated Ground Wire in accordance with applicable code requirements (refer to CAN/CSA T5238).
- .2 Ground all data cables shields and associated equipment in Telecommunications rooms to meet applicable code requirements.
- .3 Supply vertical cables and backbone cabling using cable clamps or wiring harnesses.
- .4 Conform to Telecommunications Industry Standards (refer to EIA/TIA 568A) for all cable termination and pinning assignments.
- .5 Utilize cable trays in MTER and TCs to manage cable in orderly fashion.
- .6 All sleeves containing cable or unused shall be fire sealed. Coordinate with Section 07 84 00 for provision and installation of fire barriers.
- .7 Cabling is to be run at 90 degrees to the building grid except where the distance would exceed 90m in length if installed in this manner.
- .8 The maximum horizontal run length is not to exceed 90 metres. If the 90 metre constraint cannot be met, the Cabling Contractor is to notify the Owners Designee of any cables that exceed 90 metres, prior to the installation.
- .9 Ensure all grounding conductors are rated FT-6. Tie into bundles and support using j-hooks outside of tray or conduit and fasten to under-slab at intervals not to exceed 1500 mm.
- .10 Route all cable in such a way as to ensure minimum separations are maintained from sources of EMI as defined in EIA/TIA SP-2840A.
- .11 Place all exposed cabling in TC in neat and professional manner and route as per specifications and drawings. Cables are to be combed, bundled, and routed in a neat and organized manner. Tie-wrap all exposed cable bundles at maximum of every 200 mm using black 'hook-and-loop' fastening ties.
- .12 Securely mount voice outlets at all work area locations and locate so that cable required to reach work area equipment will be no more than 3 m long.
- .13 Ensure that optical fibre splices, fusion or mechanical, do not exceed maximum optical attenuation of 0.3 dB when measured in accordance with EIA/TIA 455-34 and CSA Standard C22.2 No. 232.
- .14 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and wall plates must be performed with no splices or cuts to ensure the elimination of reflections, discontinuities, impedance, mismatches, and egress/ingress of undesired signals. Cables must be installed at a specified distance (shown below) from any electrical equipment such as radios, televisions, fluorescent lights or fixtures, motors, transformers, or other significant sources of RFI/EMI interference
- .15 Label all cables in accordance with Industry Standards and CAN/CSA T528 specifications. Number cables as per drawings.
- .16 In cases where the routing may bring the cable in close proximity to the above mentioned sources of disruption, the following minimum distances must be maintained:
 - .1 125 mm (5 inches) from power lines of 2 kVA or less.

- .2 305 mm (12 inches) from lighting (including fluorescent).
- .3 914 mm (36 inches) from power lines of 5 kVA or greater
- .4 40 inches from transformers and motors
- .17 As well, cables must be routed to avoid direct contact with steam pipes or other heat sources so as to avoid thermal degradation of the cable insulation or other undesired effects.
- .18 Cables shall be located in ceiling spaces neatly, tied in bundles and installed in cable management "trays", J-hooks, and conduit as indicated on the drawings.
- .19 All cables entering the wiring closets must be neatly dressed in bundles and run to the appropriate terminating location.
- .20 Each cable sheath must be clearly and permanently identified with a labelling scheme acceptable to the owner. Each patch panel port must be clearly and indelibly marked with a structured, user friendly numbering scheme. This numbering scheme must be capable of accepting cable additions so as not to disrupt the logical flow of the scheme. All testing documentation is to reference this numbering scheme.
- .21 NOTE: The faceplate identification numbers/tags MUST be added to the electronic versions of the floor plans. This will be considered part of the As Built contract closeout submittals. The electronic version of the floor plan will be provided in ACAD 14 format by the consultant.
- .22 The wiring closets shall be labelled C1 etc.
- .23 Fibre optic cable installation procedures shall be as follows:
 - .1 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and must be performed with no splices or cuts to ensure the elimination of reflections, discontinuities, excess signal loss, or other undesirable problems.
 - .2 All fibre cables shall be installed in conduits from end-to-end.
 - .3 If, during the course of cable installation, it is necessary to bore holes through a firewall, the holes must be sealed with an acceptable sealing material of compound once the cables are in place.
 - .4 All cables entering the computer room must be neatly dressed in bundles and run to the appropriate terminating location.
 - .5 Cable runs shall be free of tension at both ends as well as over the length of the run.
 - .6 Each cable sheath must be clearly and permanently identified at each end using an appropriate labelling scheme accepted by the Owner.

3.03 Cable Identification and Labels

- .1 To Section 27 05 53.
- .2 All adhesive cable labels shall meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition the labels shall meet the general exposure requirements in UL 969 for indoor use.

- .3 Cable labels shall be of self-laminating vinyl construction with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.
- .4 All labels must be mechanically printed using a laser printer. Hand written labels are not permitted.
- .5 Labels are to be attached to:
 - .1 front of the IDC connector or communication outlet faceplate
 - .2 each patch panel jack
 - .3 each end of the horizontal cable at maximum distance of 50mm from the end of the sheath
- .6 Affix faceplate label printed with Workstation Identification number to faceplate cover of in-tile service box.

3.04 Site Tests and Inspections

- .1 All UTP distribution cabling must be tested with a specialized UTP cable tester to measure the following characteristics:
 - .1 DC Resistance
 - .2 Characteristic Impedance
 - .3 Cable Length
 - .4 Pair Sequence Testing
 - .5 Hardcopy checklists indicating room number and faceplate ID, should be prepared, These results should be documented and form part of the Certification Report, Any documentation supplied in hardcopy form should also be supplied in electronic format (suitable word processing file, spread sheet, graphics file (e.g. AutoCAD, etc.).
 - .6 In addition to the above UTP testing, each cable and termination must be tested to 100 MBS standards.
 - .7 The specific tests to be performed, after all jack plates are mounted on boxes and labelled, are as follows,
 - .1 Mutual Capacitance
 - .2 Attenuation
 - .3 Near End Cross Talk
- .2 Fibre Optic Cable Testing Procedure
 - .1 System acceptance tests must be performed to verify that the cable plant can be certified fully operational. All optical fibre strands must be properly measured with approved optical fibre test equipment for the following characteristics:
 - .1 End to end attenuation loss in dB as measured by a calibrated optical power meter.
 - .2 Splice loss (if any)
 - .3 Cable length
 - .2 The above results are to be obtained by the following test procedures:

- .1 Power meter and light source.
 - .2 OTDR - provide hard copy of signature trace in report.
 - .3 Detailed results of these tests must be included as part of a Certification Report.
 - .4 No connector should exceed 0.5 dB loss. Splices shall not exceed 0-3 dB loss. Total attenuation of link including fibre cable, connectors and splices shall not exceed 5 dB.
- .3 These test results must be documented and form part of the Certification Report.

End of Section

1 General

1.01 Section Includes

- .1 Communications conductors and cables for fire detection, suppression, and alarm systems.
- .2 Conduit for fire detection, suppression, and alarm systems.

1.02 Related Requirements

- .1 Section 28 01 80.71 – Revisions and Upgrades of Fire Detection and Alarm.

1.03 Definitions

- .1 ULC-S524: CLASS A CIRCUIT (Return Loop Circuit) – A circuit having one continuous path connecting all components on the circuit and terminating through an alternate connection path in the source enclosure.
- .2 ULC-S524: CLASS B CIRCUIT (Terminated Circuit) – A circuit having one continuous path connecting all devices on the circuit and terminating at an end-of-line device.

1.04 References

- .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (28th edition/2021).
- .3 CSA C22.2 No. 208-14 – Fire Alarm and Signal Cable.
- .4 CAN/ULC-S139:2017 – Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables.
- .5 CAN/ULC-S524-14 – Standard for the Installation of Fire Alarm Systems.

1.05 Delivery, Storage, and Handling

- .1 In accordance with Division 01.

1.06 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 Conduit and Wire for Fire Alarm System

- .1 Conduit:
 - .1 In accordance with Section 26 05 33.13.
 - .2 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.

2.02 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 Certified by CSA as fire alarm and signal cable type FAS 105 to CSA C22.2 No. 208.
- .4 Conductors:
 - .1 300 V rated multiconductor, insulated, colour coded, copper conductor.
 - .1 Use solid conductors unless noted otherwise.
 - .2 Use stranded conductors for connections between closest junction box and vibrating equipment i.e. generator set supervisory connection.
 - .2 Minimum 16 AWG for initiation circuits.
 - .3 Minimum 12 AWG for strobe signal circuits.
 - .4 Minimum 14 AWG for horn signal circuits.
 - .5 Minimum 12 AWG for bell signal circuits.
- .5 Non-Fire resistive cable:
 - .1 Insulation: 105°C flame retardant PVC.
 - .2 Outer Jacket: 105°C flame retardant PVC Red.
 - .3 Armour: Interlocking aluminum without overall Jacket. For drops to devices in suspended ceilings from conduit system.
- .6 Fire resistive 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 Substitution: VITALink CIC Type FAS105, manufactured by Comtran (listed by ULC under ULC category code 'FHIT7' and 'FHJR7', dated 19 May 2015), installed in EMT conduit.
 - .3 Substitutions such as "Lifeline" installed in conduit may only be considered if listed by ULC under ULC Category Code 'FHIT7'.

3 Execution

3.01 Installation

- .1 All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

- .2 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.
- .3 The contractor shall furnish all labour, conduit, wiring, outlet boxes, junction boxes, cabinets, and similar devices necessary for installation of system devices.
- .4 Provide all necessary power supply, interconnecting and remote signal wire in dedicated conduit throughout and installed in accordance with the manufacturer's wiring diagrams and the requirements of the Ontario Electrical Safety Code and the Inspection Authority.
- .5 All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.
- .6 Install all wiring in metal raceways.
- .7 Provide wiring suitable for fire alarm circuits.
 - .1 Class A wiring for initiating circuits.
 - .2 Class B wiring for signalling circuits.
- .8 Fire resistive conductors:
 - .1 Install fire resistive conductors in accordance with the manufacturer's installation guidelines.
 - .2 Install 2 hour fire resistive cables for fire alarm circuits as required by the building code where transponders (data gathering panels) or annunciators are installed in a separate fire compartment from the main FACP CPU.
 - .3 Install 2 hour fire resistive cables for fire alarm system branch circuits where the transponder or DGP is not within the same storey as the first initiation, signalling, or voice communication device in the loop for that storey.
 - .4 In lieu of fire resistive cables for the above noted cases, Contractor may, when reviewed beforehand by the Consultant, install non rated conductors in be located in a service space that is separated from the remainder of the building by a fire separation that has a fire resistance rating of not less than 2 hours.

3.02 Site Tests and Inspections

- .1 The manufacturer's representative shall perform an inspection of the fire alarm equipment. The inspection shall comprise an examination and test of such equipment for the following:
 - .1 That the type of conductors and cables installed are that designated by the specifications.
 - .2 That the specified equipment has been installed in accordance with the manufacturer's recommendations.
 - .3 That the supervisory wiring of all devices connected to a supervised circuit is operating and that the wiring has 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.

End of Section

1 General

1.01 Summary

- .1 This Section covers the supply and installation of a complete Communications Copper Horizontal Cabling system. The scope of work includes, but is not limited to, the following tasks, as well as all tasks specified by the Consultant or the Owner, stipulated in the Contract Documents, or required for proper completion and commissioning of the system.
 - .1 Supply, delivery, supervision, coordination, installation, testing and commissioning of a complete horizontal copper cabling system, as specified in the present document, the Contract Documents, and the Drawings.
 - .2 Submittal of complete documentation, including, certifications, test reports, progress reports, warranty certificates, manuals, as-built drawings, as specified in the present document and the Contract Documents, and as requested by the Consultant and the Owner for the purpose of proper completion of the project.
- .2 Contractor shall examine, and is responsible for complying with, the Contract Documents in their entirety, including all relevant Drawings and Specification presented in other Sections and Divisions, regardless of whether such Drawings and Specification are referenced in this Section.
- .3 Contractor shall provide, install and test a complete Communications Copper Horizontal Cabling system as follows.
 - .1 Contractor shall furnish and install all horizontal cabling system equipment, including:
 - .1 Horizontal Cables (Permanent links, patch cords and equipment cables).
 - .2 Termination Hardware.
 - .3 Telecom Outlets.
 - .4 Patch Panels.
 - .5 Device Connection.
 - .6 Testing (Including cable and channel verification, qualification and certification).
 - .7 Administration and Identification.
 - .2 Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment, even if such work or components are not specifically mentioned in the Specification or the Drawings.
 - .3 Contractor shall provide system testing and demonstration, proper commissioning, system documentation, as-built drawings, training and installation manuals, and adequate training for the Owner's personnel, without claim for additional payment.
- .4 Errors, Omissions and Conflicts:
 - .1 Contractor shall notify the Consultant no later than ten (10) days prior to submitting the bid of any errors or omissions encountered in the Drawings, Specification, or other Contract Documents.
 - .2 Contractor shall use the more expensive material or method whenever a conflict is encountered between or within Drawings and Specification, unless Contractor has requested received a written response (addendum) as to which material or method is suitable.

.5 Related Requirements:

- .1 Division 07 – Thermal and Moisture Protection.
- .2 Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- .3 Section 27 08 11 – Testing of Structured Cabling Systems.

1.02 Acronyms and Abbreviations

- .1 ANSI - American Northern Standards Institute.
- .2 AWG - American Wire Gauge.
- .3 BICSI - Building Industry Consulting Service International.
- .4 TDMM - Telecommunications Distribution Methods Manual (BICSI).
- .5 EIA - Electronics Industry Alliance.
- .6 IEEE - Institute of Electrical and Electronics Engineers.
- .7 ISO - International Standards Organization.
- .8 OESC – Ontario Electrical Safety Code.
- .9 NFPA - National Fire Protection Agency.
- .10 NRTL - Nationally Recognized Testing Laboratory.
- .11 TIA - Telecommunications Industry Association.
- .12 UL - Underwriters Laboratories.

1.03 References

- .1 Most recent editions and addenda of the following documents:
 - .1 ANSI/TIA-568 - Commercial Building Telecommunications Cabling Standard Set
 - .2 ANSI/TIA-569 - Telecommunications Pathways and Spaces
 - .3 ANSI/TIA-606 - Administration Standard for Telecommunications Infrastructure
 - .4 ANSI/TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 - .5 ANSI/TIA-862 - Structured Cabling Infrastructure Standard for Intelligent Building Systems
 - .6 ANSI/TIA-942 - Telecommunications Infrastructure Standard for Data Centers.
 - .7 ANSI/TIA-1179 - Healthcare Facility Telecommunications Infrastructure Standard.
 - .8 ANSI/TIA-4966 - Telecommunications Infrastructure Standard for Educational Facilities.
 - .9 BICSI/TDMM - Telecommunications Distribution Methods Manual.
 - .10 TIA-TSB-162 - Telecommunications Cabling Guidelines for Wireless Access Points.
 - .11 CSA C22.1 - Canadian Electrical Code Part 1.

- .12 UL 444 - Standard for Safety of Communications Cable.
- .13 UL 1666 - Standard for Safety of Flame Propagation Height.
- .14 Local Authority Having Jurisdiction (AHJ).
- .15 Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the OESC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.

1.04 System Description

- .1 The Contractor shall provide, install, test, label and document a complete horizontal structured cabling system, spanning from a centralized telecom room(s) (TR) to the telecom outlets (TO), in a star network topology. The main components of the system are specified below.
- .2 Horizontal Cabling
 - .1 The horizontal cabling system extends from the telecom room (TR) or telecom enclosure (TE) to the work area telecom outlet (TO). It includes horizontal cable, hardware terminations, jumpers, patch cords, and may incorporate multiuser telecommunications outlet assemblies (MUTOAs) and consolidation points (CPs).
 - .2 Maximum horizontal cable length shall be 90 m (295 ft.), independently of media type. Where an MUTOA is deployed, the maximum horizontal copper cable length shall be adjusted accordingly.
- .3 Telecom Room / Enclosure (TR / TE)
 - .1 Telecom Room (TR) is a dedicated and controlled space on each building floor, used for housing telecommunications equipment, cable terminations, and cross-connect hardware serving that particular floor. TR constitutes the recognized connection point between horizontal and backbone cabling systems. The telecom standards (ANSI/TIA, BICSI TDMM, etc.) require a minimum of one telecom room, closet, or enclosure per floor.
 - .2 Telecom Enclosure (TE) usage is project-specific rather than a standard requirement. TE is intended to serve relatively smaller floor area, and is often used to extend the space and reach of a TR.
- .4 Pathways and Raceways
 - .1 Pathways and raceways are conveyance and routing systems for distributing, supporting and protecting telecom infrastructure cabling systems. Pathway system type and installation method shall be suitable for the media being supported and the environment being traversed.
 - .2 Pathway and raceway systems shall conform to the standards specified and referenced in Section 27 05 28 and Section 27 05 36.
 - .3 Pathway design shall combine continuous cable trays and non-continuous cable supports. Cable trays should, nonetheless, form the main horizontal cabling pathway, and should be located over the main corridors, to facilitate access and maintenance tasks.
 - .4 In low cable density areas, non-continuous supports shall be used in lieu of a cable tray system, unless otherwise specified in the design documents.
 - .5 In open-ceiling spaces where the cable is exposed, a conduit or a surface raceway shall be used in lieu of non-continuous supports, to enhance cable protection and aesthetic appearance.

1.05 Submittals

- .1 Provide submittals in accordance with Division 01.
- .2 Shop Drawings
 - .1 Contractor shall submit shop drawings for all components and equipment used in the project, including, the items listed below.
 - .1 Modular Connectors.
 - .2 Telecom Outlet Faceplates.
 - .3 Horizontal Cable.
 - .4 Patch Panels.
 - .5 Patch Cables and Equipment Cords.
 - .6 Telecommunications Enclosures and Racks.
 - .7 Cable Management Components.
 - .8 Pathways and Raceways (Cable Trays, Cable Supports, Conduits, etc.).
 - .9 Firestopping Material.
- .3 General Component Data
 - .1 Contractor shall submit the information and documents outlined below, with respect to all components and products covered under this Section or installed as part of communications copper horizontal cabling:
 - .1 Product Name, Manufacturer Name, Model Number and Part Number.
 - .2 Product Datasheets and Specifications.
 - .1 Complete specification, including but not limited to, standards compliance, Category type, fire rating, environmental rating, number and color code of pairs, conductor size and material, insulation type and material, performance and attenuation parameters, near-end cross talk (NEXT), cable diameter and weight, jacket type and material, cable color, etc.
 - .3 Product Manuals (Installation Instructions, User Manuals, Maintenance Manuals).
- .4 Deviations
 - .1 Contractor shall be responsible for any deviation from Contract Documents, regardless of whether such deviation or associated drawings and samples have been reviewed by the Consultant, unless deviation has been approved in writing by the Consultant and the Owner.
 - .2 Contractor shall submit an indexed sheet detailing all deviations from Contract Documents, and shall be responsible for all such deviations, unless these have been expressly approved in writing by the Consultant and the Owner.
 - .3 Contractor shall not assume that an approval of an item's shop drawing or sample is equivalent to an approval of the item itself. Deviations shall be treated specifically, and shall be approved separately as such, in writing by the Consultant and the Owner.

- .4 Contractor shall be responsible for all deviations, errors and omissions in the submittal documents and process, regardless of whether such deviations, errors and omissions have been reviewed by the Consultant or the Owner.

1.06 Closeout Submittals

- .1 Testing and Test Results
 - .1 Refer to Section 27 08 11.
 - .2 Specification and calibration sheets for all test equipment.
 - .3 Contracting firm qualifications and certifications.
 - .4 Installation team qualifications (by person).
 - .5 Test results (Intermediate and final test results, as specified in Part 3 - Execution).
- .2 Contractor shall submit final closeout documents as required by the Consultant and the Owner. These shall include, but are not limited to, the following items.
 - .1 Test results covering all cable segments and links, in native tester and PDF formats, or as otherwise specified by the Consultant.
 - .2 Manufacturer and contractor warranties.
 - .3 Complete project manual set, including, product datasheets, material submittals, training manuals, user manuals, maintenance manuals and preventive maintenance plan.
 - .4 Spare parts recommendation list.
- .3 Contractor shall submit a complete set of as-built drawings in an accessible AutoCAD format, as specified by the Consultant and the Owner. As-built drawings shall cover the following.
 - .1 Precise location and identification (labels) of all equipment, including, all data outlets, cables, cable trays, patch panels, racks, telecom rooms and enclosures, and all other equipment which is part of the horizontal cabling system.
 - .2 Detailed floor plans of all telecom rooms and spaces.
 - .3 Detailed layout of all racks, patch panels, cable trays, pathways, conduits.
 - .4 Detailed layout of all pathways, cable trays, and cable routes.
- .4 Contractor shall submit and mount on the wall of each telecom space or room, detailed as-built drawings depicting the floorplan, floor area, TO points, and cabling layout, for that space or room. Drawings shall be printed on ANSI C paper size or larger, shall be laminated, and shall be approved and wall-mounted in coordination with the Consultant and the Owner.

1.07 Quality Assurance

- .1 Standards for Materials and Equipment
 - .1 Contractor shall provide all materials, equipment, and installations, in compliance with the latest applicable standards.
- .2 Installer Qualifications
 - .1 Refer to Section 27 05 00 – Common Work Results for Communications.

1.08 Warranty

- .1 Contractor shall ensure each piece of equipment installed including wiring is warranted by the manufacturer to be free of defects in operation, material, and workmanship for a period of 15 years from date of Substantial Completion.

2 Products

2.01 Manufacturers

- .1 CommScope Systemax.
- .2 Panduit TX6000.
- .3 Belden DataTwist.

2.02 Category 6 Data Communications Horizontal Cable

- .1 Category 6 (Class E) cable shall meet ANSI/TIA-568.2-D Category 6 component standard. Cable conductors shall consist of 23 AWG copper wires and shall be twisted in pairs. In addition, Category 6 cable shall comply with the following specifications and standards.
- .2 General Requirements
 - .1 Cable shall consist of 4 unshielded twisted pairs with no outer shielding (Cat 6 U/UTP), unless otherwise specified in the design and expressly approved by the Owner.
 - .2 Cable used in data networking systems shall have a blue color jacket.
 - .3 Cable conductor insulations shall be color coded in compliance with the TIA-568 standard.
 - .4 Cable individual conductors shall be 23 AWG copper wires. Special applications requiring the use of the thinner 24 AWG conductor shall be specified and expressly approved by the Owner.
 - .5 Permanent links horizontal cable extending from the telecom enclosure/room to the telecom outlet shall have solid conductors.
 - .6 Equipment cable and patch cords shall have stranded conductors.
 - .7 Cable shall be properly rated for its use application and its installation environment (Outdoor/OSP, Plenum/CMP, Riser/CMR, LSZH, Industrial/Armored, Direct Burial, etc.), as required by the local and national codes.
- .3 Standards Compliance and Technical Specification
 - .1 Category 6 cable shall satisfy the following compliance and technical specification.
 - .2 Cable shall exceed requirements of ANSI/TIA-568.2-D Category 6 and ISO 11801 2nd Edition Class E channels standard.
 - .3 Cable shall exceed requirements of ANSI/TIA-568.2-D and IEC 61156-5 Category 6 components standard.
 - .4 Cable shall meet requirements of IEEE 802.3af, IEEE 802.3at and IEEE 802.3bt for Power over Ethernet (PoE) applications.
 - .5 Cable shall meet TIA TSB-184-A / IEEE 802.3bt cable requirements, and UL listed CMP-LP (0.5A).

- .6 Cable shall be characterized up to 550 MHz, 300 MHz above the range specified in the standard.
- .7 Cable shall be third-party tested and verified for compliance with ANSI/TIA-568.2-D, Category 6.
- .8 Cable shall support IEEE 802.3 for 1000BASE-T (Gigabit Ethernet), 100BASE-T (fast Ethernet), and 10BASE-T applications up to 100 metres.
- .4 Safety Standards
 - .1 Category 6 cable shall strictly meet the following specification to achieve compliance with the local and national (CSA) safety codes and standards:
 - .2 Cable deployed in the plenum and/or raised floor space (whether partly or entirely) shall be plenum CMP rated and shall comply with the CSA FT6 or NFPA 262 (UL-910) fire test standards.
 - .3 Cable running between floors in non-plenum area shall be riser CMR rated and shall comply with the CSA FT4 and UL-1666 fire test standards.
 - .4 Plenum CMP rated cable (CSA FT6 or NFPA 262) may be used in riser applications, if needed. Riser CMR rated cable, however, is not approved for use and shall not be deployed in plenum space.
- .5 Temperature Rating
 - .1 Installation Temperature Range: 32°F to 122°F (0°C to 50°C)
 - .2 Operating Temperature Range: - 4°F to 167°F (- 20°C to 75°C)

3 Execution

3.01 General

- .1 Comply with the design requirements and industry standards, and with the applicable local and national codes.
- .2 Follow best practices guidelines and applicable industry standards for the installation of the cable and all horizontal channel components.
- .3 Ensure that patch panels, connectors, and all structured cabling components are compatible with the Category rating of the cable. For example, if Category 6A cable is used; then, all structured cabling components shall be Category 6A compatible.
- .4 Ensure that all materials, components and equipment being installed are properly rated (Plenum or Riser), as required by local and national codes.
- .5 Install all cables and horizontal channel components (connectors, outlets, faceplates, jacks, etc.) as instructed in the manuals and specified in the Drawings.
- .6 Provide all installation and mounting accessories and components, such as, screws, anchors, clamps, hooks and loops, grounding and support hardware, etc., as required to carry out the installation of the cabling system.
- .7 Furnish all special installation equipment or tools, as needed to properly complete the installation.
- .8 Provide appropriate underlay for storage of cable reels. Rolling of cable reels is not permitted.

- .9 Provide all additional material and labour required to rectify a situation arising from their failure to comply with applicable standards and best practices guidelines. This equally applies to all damage inflicted to cables by Contractor during the installation process.
- .10 Provide fire blocking material at all fire rated penetrations, as required by design, standards, and codes.
- .11 Seal all conduits where cabling has been installed with re-enterable duct sealing system, as required by design, standards, and code.
- .12 Provide and install bushings on all conduit ends.
- .13 Ensure means and methods promote ease of access to cables for maintenance and testing purposes.
- .14 The pathways shown on the Drawings are an approximate representation, and should not be interpreted as an absolute and accurate layout. Conduct site surveys, and coordinate with other trades, as required, in order to determine the exact final pathway layout.

3.02 Horizontal Cabling Guidelines

- .1 Comply with best practices guidelines for horizontal cabling systems.
- .2 Install horizontal cabling in a continuous run, from the TR patch panel to the peripheral telecom outlet. Spliced copper cable is not permitted.
- .3 Group and bundle all cables by power level and cable type. Use “hook and loop” fasteners for bundling cables.
- .4 Do not exceed the maximum cable pulling tension specified by the manufacturer.
- .5 Terminate and test all cables.
- .6 Install all patch panels inside the data racks, at the specified telecom spaces. Coordinate with the Owner for installation of network switches.
- .7 Perform all cabling tasks in compliance with best practices guidelines, and applicable industry standards, particularly, BICSI'S TDMM and ANSI/TIA-568.
- .8 Ensure that all horizontal cables, including any required service loops, do not extend beyond 90 m (295 feet). Identify any areas that cannot be reached within the 90 metre constraint, and report them to the Consultant. Contractor shall strictly adhere to this rule, unless a written approval has been issued by the Consultant.
- .9 Provide cable slack (service loop) at both ends of the cable for maintenance or future cabling system changes. The recommended lengths (BICSI TDMM) are:
 - .1 Minimum of 3 metres in the telecommunications closet for both twisted-pair and fiber cable
 - .2 Minimum 1 metre for fiber at the outlet.
 - .3 Minimum 30 cm for twisted-pair cable at the outlet.
- .10 Ensure that all equipment installed in the horizontal channel including but not limited to, cable, pathways, conduits, connectors, is properly rated in compliance with local and national codes. All cables and components installed partly or entirely in the plenum space shall be plenum rated. All cables or components installed partly or entirely in the riser space shall be riser rated. All cables or components installed partly or entirely outdoors shall be weatherproof and OSP (outside plant) rated.

- .11 Install all cable pathways and conduits perpendicular or parallel to the ceiling structure, unless otherwise specified in the Drawings.
- .12 Exercise care and follow proper guidelines during cable installation in order to prevent damage to cable and equipment. Use grommets to protect cable where conduit or chase nipples are not installed around cut-outs or knockouts.
- .13 Contractor shall not expose cable to water, paint overspray, paint removal products, water-based pulling lubricants, or any other substances or environments which can damage or compromise the integrity of the cable.
- .14 Provide metallic isolation barriers to isolate different wiring groups, where cables with different classifications share a common box or enclosure.
- .15 Coordinate as needed with the electrical and mechanical trades in order to implement a proper earthing and bonding system, and an effective Electromagnetic Compatibility (EMC) scheme.
- .16 Mitigate electromagnetic interference (EMI) by maintaining the recommended separation between telecom and power (EMI) sources, as specified by ANSI/TIA-569 and shown in the table below.

Minimum Separation Distance Between Power and Data Cables (ANSI/TIA-569)			
	Minimum Separation Distance		
Condition	< 2 kVA in (mm)	2 - 5 kVA in (mm)	> 5 kVA in (mm)
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways	5 (127)	12 (305)	24 (610)
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway	2.5 (64)	6 (152)	12 (305)
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway		3 (76)	6 (152)
Electrical motors and transformers			48 (1,220)

- .17 Do not install telecom cables and power cables in the same pathways, cable trays, or conduits.
- .18 Provide vertical cable support for all cables installed in vertical cable trays, using properly sized vertical cable supports on every third floor. Use of nylon cable ties is not permitted.

3.03 Cable Installation in Conduit and Duct

- .1 Apply best practices when pulling cable inside conduits and ducts.
- .2 Ensure that pulling tension never exceeds the manufacturer's specification.
- .3 Ensure that cable bending during installation conforms to the manufacturer's specifications.
- .4 Use a pull mandrel one size smaller than the conduit.
- .5 Use cable pulling lubricant to reduce friction and tension during cable pulling.

- .6 Use a dynamometer to measure pulling tension in the case of long or difficult installations.
- .7 Use pulling grips suitable for copper cable installations. Contractor shall consult the cable manufacturer to determine the suitable pulling grip and method of attachment.
- .8 Seal loose cable ends using cable caps (heat-shrinking type) to protect them until they are terminated.
- .9 Use corner blocks to facilitate the bending of cable. Contractor should use 45° cable block for bends between 5° and 45°, and 90° corner block for bends between 45° and 90°.

3.04 Cable Bundling Material

- .1 Contractor shall use the appropriate cable bundling and securing material, in line with industry and best practices standards, to ensure cable runs are securely held in place, both vertically and horizontally.
- .2 Contractor shall not tighten bundling and securing ties and straps around cables, to avoid deforming cable geometry, and as a result, cable performance.
- .3 Contractor shall only use safe and soft cable fasteners to bundle or secure cable, such as, "hook and loop" cable fasteners. The use of regular plastic cable ties is strictly forbidden.
- .4 Contractor shall not attach or secure cable runs to other building systems (such as, electrical or mechanical conduits, HVAC ducts, sprinkler pipes, ceiling suspension members, etc.).
- .5 Contractor shall strictly use plenum rated cable bundling components inside suspended ceilings, raised floors, and air-handling spaces.

3.05 System Administration

- .1 Refer to Section 27 05 53 – Identification for Communications Systems.
- .2 Conform to the system administration guidelines of ANSI/TIA-606, Administration Standard for Telecommunications Infrastructure.
- .3 Propose a consistent and comprehensive system administration scheme in coordination with the Consultant, the Owner and all stakeholders. Contractor shall seek the Consultant's or the Owner's written approval of the proposed scheme ahead of implementation.
- .4 Uniquely identify all components of the installed system by location, function, unit, and sub-unit.
- .5 Identify each location, telecom space, telecom room or enclosure in the building with a unique alphanumeric identifier.
- .6 Identify each system component, including but not limited to, adapter modules, connectors, cables, patch panels, patch and equipment cords, cable management devices, grounding system components, power cords, faceplates, outlets, cable trays and pathways, racks, enclosures, etc. with a unique alphanumeric identifier.
- .7 Contractor shall supply all the required records and documentation in compliance with ANSI/TIA 606.
- .8 Contractor shall provide an ODBC-compliant database (Open Database Connectivity), for administration of the cabling system described in this Section.

3.06 Identification

- .1 Contractor shall seek the =Consultant's and the Owner's approval of the project's labeling plan, ahead of cable installation.
- .2 Labeling Cables

- .1 Mark each cable at each endpoint and at all intermediate pull and access points, and junction boxes with labels that indicate the origin and destination identifiers, the sheath identifier, and the strand or pair range.
- .2 Contractor shall mark each horizontal cable on the sheath at each end with the TR, patch panel, and panel port where cable is terminated.
- .3 Labeling Conduits and Pathways
 - .1 Contractor shall label conduits and pathways within 0.5 m (18 inches) of each end, on an exposed and accessible spot.
 - .2 Contractor should apply additional labeling, where possible, at every 3 m (10 feet) of exposed length.

3.07 Cable Testing

- .1 Refer to Section 27 08 11 for cable testing procedures.
- .2 Ensure all testing procedures and field-test instruments comply with the requirements of:
 - .1 ANSI/TIA-1152-A, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
 - .2 ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises
 - .3 ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard
 - .4 ANSI/TIA 568.2-D, Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- .3 Provide all labor, materials, tools, field-test instruments and equipment required for the complete testing of the work.
- .4 Test all horizontal UTP cables as instructed below.
- .5 Perform tests using a level IV accuracy cable tester, updated with latest firmware.
- .6 Provide all test records in both "native" and pdf formats, as part of the as-built package.
- .7 Unless otherwise specified by the Consultant or the Owner, all horizontal links and channels shall be tested for the following:
 - .1 Wire Map.
 - .2 Length.
 - .3 Propagation Delay.
 - .4 Delay Skew.
 - .5 DC Loop Resistance.
 - .6 Insertion Loss.
 - .7 NEXT (Near-End Crosstalk).
 - .8 PS NEXT (Power Sum Near-End Crosstalk).

- .9 ACR-N (Attenuation to Crosstalk Ratio Near-End).
- .10 PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End).
- .11 ACR-F (Attenuation to Crosstalk Ratio Far-End).
- .12 PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End).
- .13 Return Loss.
- .8 All horizontal links and channels shall pass the test requirements for respective cable Category, as specified in ANSI/TIA-568.2-D. Category 6 and 6A cables shall be tested up to 250 MHz and 500 MHz, respectively.
- .9 Any cable or link that fails the requirements shall be identified and corrected.

3.08 Firestopping

- .1 Comply with the requirements of Section 07 84 00 – Firestopping.
- .2 Comply with the requirements of the latest TIA/EIA-569, Annex A, Firestopping.
- .3 Comply with the requirements of the latest BICSI TDMM, Chapter 7, Firestop Systems.
- .4 Firestop systems shall meet the requirements of ULC Standard CAN/ULC-S115.

End of Section

1 General

1.01 Section Includes

- .1 Modifications to existing fire alarm system, including provision of new zones as indicated, relocating and new fire alarm devices as indicated on the drawings, and system verification. Complete systems shall be left ready for continuous and efficient satisfactory operation.
- .2 Update annunciators / passive graphic to include additions and renovated areas, as applicable.
- .3 New devices connected directly to the existing fire alarm system shall of the manufacturer's current product selection, and to match the existing system.

1.02 Related Requirements

- .1 Section 21 13 00 – Fire-Suppression Sprinkler Systems.
- .2 Section 26 05 33.13 – Conduit for Electrical Systems.
- .3 Section 26 05 33.16 – Boxes for Electrical Systems.
- .4 Section 26 05 33.23 – Surface Raceways for Electrical Systems.
- .5 Latest fire alarm verification or annual inspection report.

1.03 References

- .1 The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only. Comply with latest edition/amendment referenced Code/Publication.
 - .1 2012 Ontario Building Code.
 - .2 2007 Ontario Fire Code.
 - .3 CAN/ULC-S524:2019, Standard for Installation of Fire Alarm Systems.
 - .4 CAN/ULC-S537:2019, Standard for Verification of Fire Alarm Systems.
 - .5 CAN/ULC-S1001-11, Integrated Systems Testing of Fire Protection and Life Safety Systems.
 - .6 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .7 Ontario Electrical Safety Code (28th edition/2021).
 - .8 All requirements of the Authority Having Jurisdiction (AHJ).

1.04 Submittals

- .1 Provide submittals to the Consultant for review in accordance with Division 01.
- .2 Submit to the Fire Department, drawings showing bells, manual pull stations, complete wiring diagrams and annunciator details and obtain their approval.
- .3 Shop Drawings
 - .1 Include sufficient information, clearly presented, 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 active graphic to be included with submittal package.
- .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 indicating 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.

1.05 Closeout Submittals

- .1 Fire Alarm Verification Report.
- .2 Operation and Maintenance Manual.
- .3 Training session attendance list.

1.06 Quality Assurance

- .1 Approvals
 - .1 The system shall have proper listing and/or approval from the following nationally recognized agencies:
 - .1 ULC Underwriters Laboratories Canada.
 - .2 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.
- .2 All devices/components shall be suitable for the locations, environment, temperatures in which they are to be installed.

1.07 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 (1) year from the date of acceptance.

2 Products

2.01 Existing System

- .1 The existing Fire Alarm System is Edwards EST series single-stage fire alarm system.
 - .1 The location of the Fire Alarm Control Panel is as indicated on the drawings.
 - .2 There is one passive graphic annunciator to be updated, location as indicated on the drawings.

2.02 Manufacturers

- .1 The system components shall be selected so as to match and be compatible with the existing Fire Alarm system.

2.03 Equipment and Material, General

- .1 Review latest verification report, and review existing system during tender walkthrough and note all required modifications.
- .2 All equipment and components shall be new, and the manufacturer's current model.
- .3 All equipment and components shall be installed in strict compliance with manufacturers' recommendations.
- .4 All Equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.04 Conduit and Wire

- .1 Existing conventional zone wiring is existing to remain.
- .2 New conduit and wire for new zones and new devices to Section 27 15 01.19.
- .3 Conduit
 - .1 Conduit shall be in accordance with the Electrical Safety Authority (ESA), local and provincial requirements.
 - .2 All wiring shall be installed in conduit or raceway to Section 26 05 33.13 and Section 26 05 33.23.
- .4 Wire
 - .1 All fire alarm system wiring to suit new devices shall be new.
 - .2 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.
 - .3 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.
- .5 Terminal Boxes, Junction Boxes and Cabinets:
 - .1 All boxes and cabinets shall be listed for their purpose and use.

2.05 Main Fire Alarm Control Panel

- .1 Add new zones, zone modules, etc., for new work as required, and connect all new devices to Fire Alarm Control Panel.
- .2 Remote Annunciator and Passive Graphic
 - .1 Connect all new zones for the new work to annunciators.
 - .2 Provide new passive graphic, multicolour, under plexiglass with anodized frame and concealed tamperproof mounting.

2.06 Components

- .1 Programmable Electronic Sounders:
 - .1 Electronic sounders shall match existing system.
 - .2 Shall be flush mounted as required.
- .2 Audible/Visual Combination Devices:
 - .1 Shall meet the applicable requirements of sounders listed above for audibility.
 - .2 Shall have a built-in strobe, 15 candela.
- .3 Strobe Synchronizing Modules:
 - .1 Synchronize strobes at 1 Hz and horns at temporal over single wire pan.
- .4 Manual Fire Alarm Stations
 - .1 Manual fire alarm stations shall be non-coded, non-breakable glass type.
 - .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 An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of 30.5 m (100 ft) front or side.
 - .4 Manual stations constructed of metal, with operating instructions provided on the cover. The word FIRE shall appear on the manual station in letters 12.7 mm (1/2 in) in size or larger.
 - .5 Manual stations shall be c/w polycarbonate vandal covers.
- .5 Conventional Photoelectric Area Smoke Detectors
 - .1 Photoelectric smoke detectors shall be two wire, ceiling-mounted, light scattering type using an LED light source.
 - .2 Each detector shall contain a remote LED output and a built-in test switch.
 - .3 Detector shall be provided on a twist-lock base.
 - .4 It shall be possible to perform a calibrated sensitivity and performance test on the detector without the need for the generation of smoke. The test method shall test all detector circuits.
 - .5 A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs), on the detector, which may be seen from ground level over 360 degrees. These LEDs shall flash every 10 seconds, indicating that power is applied to the detector.
 - .6 The detector shall not go into alarm when exposed to air velocities of up to 914.4 m (3000 ft) per minute.
 - .7 The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.
 - .8 All field wire connections shall be made to the base through the use of a clamping plate and screw.
- .6 Duct Smoke Detectors

- .1 Duct smoke detectors shall be complete with visual alarm and power indicators, and a reset switch. Each detector shall be installed upon the with properly sized air sampling tubes.
- .7 Automatic Conventional Heat Detectors
 - .1 Automatic heat detectors shall have a combination rate of rise and fixed temperature rated at 135 degrees F (57.2 degrees C) for areas where ambient temperatures do not exceed 100 degrees F (37.7 degrees C), and 200 degrees F (93.33 degrees C) for areas where the temperature does not exceed 150 degrees F (65.5 degrees C).
 - .2 Automatic heat detectors shall be a low profile, ceiling mount type with positive indication of activation.
 - .3 The rate of rise element shall consist of an air chamber, a flexible metal diaphragm, and a factory calibrated, moisture-proof, trouble free vent, and shall operate when the rate of temperature rise exceeds 15 degrees F (9.4 degrees C) per minute.
 - .4 The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft.
 - .5 Automatic heat detectors shall have a smooth ceiling rating of 2 500 square feet (762 square metres).

2.07 Operation Sequences

- .1 The fire alarm system shall be a Zoned Single Stage Non-Coded System as defined in the Ontario Building Code.
- .2 Basic Performance:
 - .1 Initiation Device Circuits (IDC) shall be wired Class A.
 - .2 Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y).
 - .3 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.
- .3 Basic System Functional 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.

3 Execution

3.01 Examination

- .1 Do not disturb any existing devices unless absolutely necessary to facilitate installation of a new device. No existing devices are to be disturbed without specific authorization by the Project Manager.
- .2 Conduct an impedance test of initiation and signal circuits, and submit report to the Consultant. Report any discrepancies in circuit loading.

3.02 Installation

- .1 Maintain continuity of the existing fire alarm system at all times. In the event that a shutdown is required of the fire alarm system, provide a fire watch.
- .2 Install fire alarm system devices in accordance with applicable codes, and manufacturer's instructions.
- .3 Entire installation shall be done under supervision of manufacturer. Upon completion of installation, check entire system to approval and correct any malfunction immediately.
- .4 Sprinkler System Connections.
 - .1 Refer to Section 21 13 00.
 - .2 Connect contact of sprinkler flow switches and supervisory switches to fire alarm zones indicated.
- .5 Align alarm devices and signals, where grouped together, one above the other.
- .6 Mount devices at the following heights unless otherwise shown:
 - .1 Signal devices:
 - .1 300 mm below finished ceiling
 - .2 2050 mm above floor in unfinished areas.
 - .2 Manual Pull Stations:
 - .1 1200 mm above finished floor level.
 - .3 In areas with separate signal devices for fire suppression and/or pre-action, provide a lamacoid nameplate for base building signalling devices.
- .7 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.

3.03 Field Quality Control

- .1 Testing and Verification
 - .1 Test each automatic detector to ensure correct wiring and zoning by setting off its rate of rise component and sounding the bells or by ringing it out. Test each smoke detector, sprinkler system and standpipe valves to ensure correct wiring.
 - .2 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. All testing shall be in accordance with CAN/ULC-S537.
 - .3 Check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 - .4 Perform audibility test of space and provide annunciation devices to suit ambient sound levels. Ensure coverage for fire alarm signalling devices on base building fire alarm system. Provide audible test of signaling devices after other systems have been commissioned to verify operation at computer room ambient sound level.
 - .5 Verify activation of all relocated devices, including flow switches, trouble, and supervisory signals from the relocated pre-action assembly.
 - .6 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.
 - .7 All initial testing shall be in accordance with CAN/ULC-S537. 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.
 - .8 Include associated costs in Tender Price.
 - .9 Carry out a complete audibility test and submit report.
 - .10 On completion of the verification 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 operational.
 - .11 Provide functional testing of interconnected systems in accordance with CAN/ULC-S1001.
- .2 Manufacturer Services
 - .1 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 pinpoint 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 replacement of 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.
- .13 If existing audible signal devices have been discontinued by the manufacturer (for example mechanical horns), allow for replacement of all audible devices so that all devices generate similar sounds and sound patterns when activated.

3.04 Closeout Activities

- .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.
- .2 Provide instruction as required to the building personnel and fire and safety personnel. "Hands-on" demonstrations of the operation of the system shall be provided.

End of Section

1 General

1.01 Summary

- .1 Provide commissioning of fire alarm and interconnected systems to verify that installations are in accordance with project requirements, and to ensure proper system operation.

1.02 Related Requirements

- .1 Section 01 91 13 – General Commissioning Requirements.
- .2 Section 01 91 26.13 – Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.03 References

- .1 CAN/ULC-S1001-11 – Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.04 Submittals

- .1 Commissioning plan.

1.05 Closeout Submittals

- .1 Final commissioning and functional test report.

1.06 Qualifications

- .1 Commissioning Organizations:
 - .1 Certified member of Electrical Contractors Association of Ontario (ECAO) or Canadian Fire Alarm Association (CFAA).

2 Products – Not Used

3 Execution

3.01 Site Tests and Inspections

- .1 Provide labour and material to conduct the integrated systems testing of interconnected life safety systems in accordance with CAN/ULC-S1001-11, and provide written report for Consultant's review. Ensure all required trade contractors are present on site as directed by the Integrated Testing Coordinator during the CAN/ULC-S1001 functional testing. Refer to Section 01 91 26.13.
- .2 Follow manufacturer's recommendations for testing.
- .3 Inspect wiring connections to all devices comprising the system.
- .4 Verify supervision of wiring at every device connection to a supervised circuit.
- .5 Test operation of every device on a system to verify its function.
- .6 Examine equipment for any apparent damage or tampering that may interfere with its intended operation.
- .7 Test equipment with capabilities for field adjustment to establish that it functions as intended under the conditions prevailing at its point of installation.

- .8 Examine devices for evidence of damage or obstructions which may interfere with their operating mechanisms.
- .9 Test automatic devices by simulating an operating condition.
- .10 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.
- .11 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.
- .12 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.
- .13 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.
- .14 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.
- .15 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.

- .16 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.
- .17 Alarm signals - visual:
 - .1 The visual signal appliances shall function as intended and shall be clearly visible.
- .18 Fire suppression supervision:
 - .1 Coordinate with the requirements of Section 21 13 00.
 - .2 Sprinkler and standpipe trade to activate 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.
- .19 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.
- .20 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.
- .21 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.

3.02 Simulations of Interconnected Systems

- .1 Provide simulations of all interconnected systems in accordance with CAN/ULC-S1001.

End of Section

April 24, 2025

23-1366-02

WRDSB
c/o LGA Architectural Partners
310 Spadina Ave., Suite 100B
Toronto, ON M5T 2E8

Attention: Ed Weinberg

Re: 65 Victoria Ave., Cambridge, St. Andrews PS, ON
High and Low Roof Levels – New Condenser Units Load Check

Dear Ed:

As requested, our office has reviewed the loads imposed by the proposed condenser units, on the existing high and low roof structures. We understand that the total operating weight of the new condensers will be approximately 4,146 lbs.

In our opinion the existing high and low roof structures can safely support the weight of the condensers without reinforcing provided that:

1. The low-roof reinforcing framing shown on the 2007 renovation drawings beneath condensers CU-3A, CU-3B, and CU-3C must be site verified prior to installing the condensers.
2. The eco-foot condenser stands used at the low roof level provide a minimum of 4 bearing pads per unit.

We have based our review on the following information:

- Five (5) new Daikin condenser units are proposed for installation. Refer to Figure 1 for locations. Loading information for the individual condenser, provided by Daikin, is as follows:
 - Condenser Unit CU-1 has a total self-weight of 684 lbs. The plan dimensions of the unit are 48.8" x 30.1".
 - Condenser Unit CU-2 has a total self-weight of 750 lbs. The plan dimensions of the unit are 48.8" x 30.1".
 - Condenser Unit CU-3A has a total self-weight of 904 lbs. The plan dimensions of the unit are 68.9" x 30.1".
 - Condenser Unit CU-3B has a total self-weight of 904 lbs. The plan dimensions of the unit are 68.9" x 30.1".
 - Condenser Unit CU-3C has a total self-weight of 904 lbs. The plan dimensions of the unit are 68.9" x 30.1".
- We understand that condenser units CU-1 and CU-2 will be located on the existing wood framed high roof portion of the building, and units CU-3A, CU-3B, and CU-3C will be located on a lower roof level, east of the high roof structure.
- In our opinion, the high roof structure can safely support the weight of the condensers (CU-1 and CU-2) without the need for reinforcement.
- In our opinion, the low roof structure can safely support the weights of the condensers (CU-3A, CU-3B, and CU-3C) without reinforcement provided that each condenser unit is supported on a stand with 4 bearing pads



per stand. We understand that Eco-foot roof support system stands will be provided for each unit, providing the required minimum of 4 bearing pads per condenser. Refer to Figure 2.

- The base-building drawings indicate that the low roof structure area where the condensers are proposed for installation has previously been reinforced with 10" deep steel beams erected between 16" deep open-web steel joists. The contractor **must verify that the 10" deep steel beams have been installed per the base building renovation drawings prior to installing the new condenser units.** The contractor is to notify our office immediately should it be discovered that the 10" steel beams were not installed so that a reinforcement strategy can be prepared to facilitate the condenser installation. Refer to Figure 2.
- Base building drawings for the high roof structure were not available. Our office was on site on January 17, 2023 to measure the existing framing in the area as part of a separate project to measure the existing structure. Our office observed that the existing framing is a wood framed roof constructed of a wood plank deck supported on 1.5" wide x 11.5" deep wood joists at 16" centre-to-centre.
- We reviewed the base building structural drawings prepared by Totten Sims Hubicki Associates Limited in 2007, with S.C. Rossi being the structural Engineer of Record. Information used from these drawings as part of our review included:
 - The Partial Roof Framing Plan (Dwg. S100) indicates that the low roof is an existing wood deck supported on 16" deep open-web steel joists which have been reinforced with 10" deep steel beams between the existing open-web steel joists.
 - The design snow load for the low roof level was 40 psf plus accumulated snow loads.

Note, we recommend that the areas around the new condensers be kept clear and not be used for storage of additional materials as this added load may result in an overstressing of the roof structure

Our review is based on our assumption that the maximum operating weight of the proposed condensers will not exceed the values listed above. We do not assume responsibility for ensuring that this maximum weight is not exceeded by the substitution of the equipment with alternate models, by a change in use and/or future modifications of the equipment, and/or by changes to the equipment layout shown on attached Figures. Therefore, we caution the owner and the equipment supplier that they should discuss a procedure to ensure that the maximum weight is not exceeded over the life of the equipment



65 Victoria Ave., Cambridge, ON

April 24, 2025

23-1366-02

Page 3 of 5

Please call if you have any questions.

Regards,

Engineering Link Incorporated

A handwritten signature in blue ink, appearing to read 'R. McDonald'.

Per: Robert McDonald, P.Eng.

b: 416-599-5465 x177

c: 416-556-6239

e: Robert.M@englink.ca



Attached: Roof Plan with Proposed Equipment Location

To: Ed Weinberg

Ed@lga-ap.com

file: h:\2023\1300 - 1399\23-1366\03 let\01 23-1366-02 condenser load check.docx



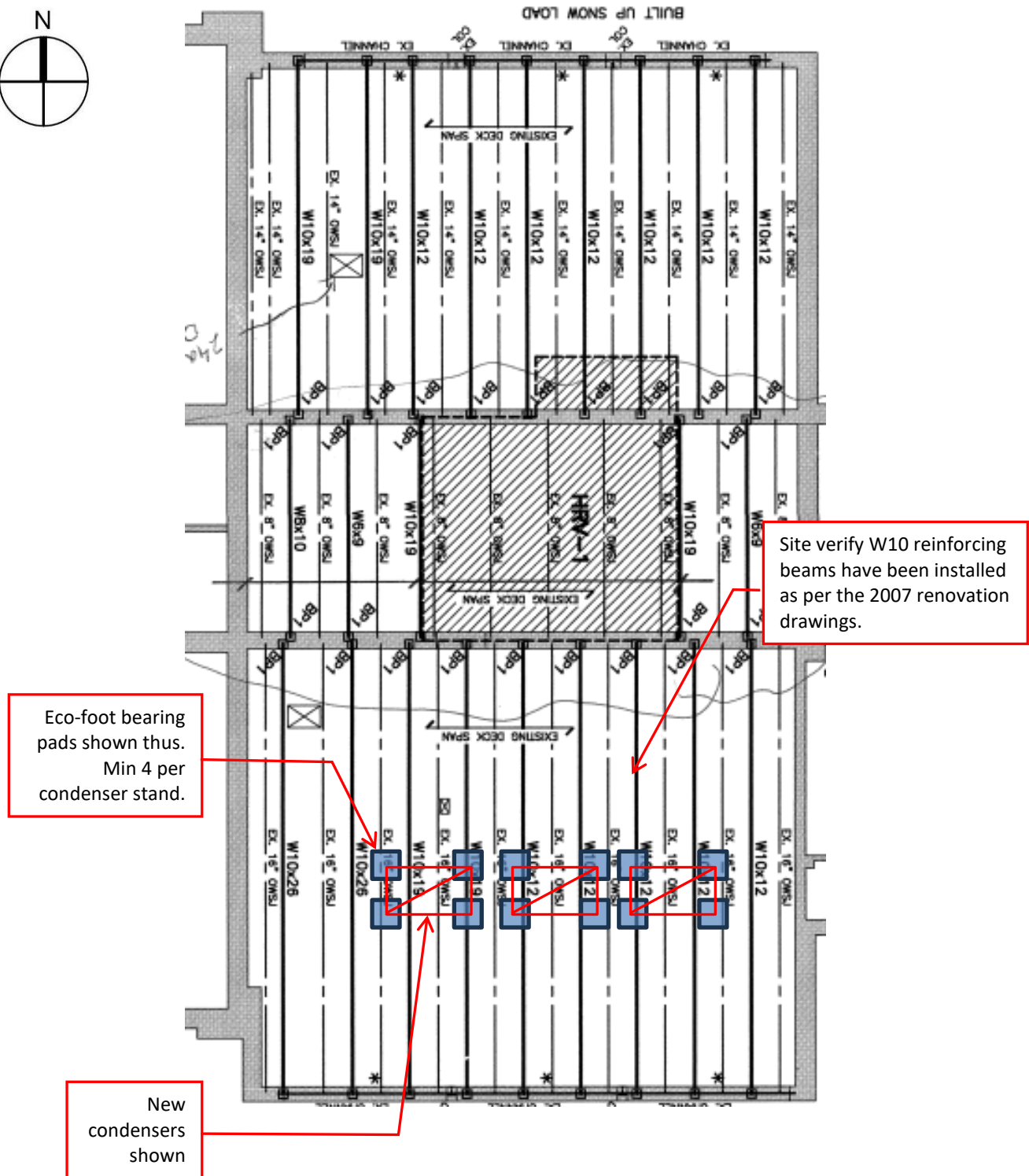


Figure 2 – Low Roof Framing Plan

25-7748-RFT - St. Andrew's Public School 3rd Floor Classroom Refinishing

Opening Date: May 2, 2025 2:00 PM

Closing Date: May 21, 2025 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

The amounts stipulated on the Bid Price Form(s) are intended to cover the cost of the complete Work as described in this Procurement and must remain fixed and firm for the term of the Contract unless otherwise specified in this Procurement.

All prices shall be in Canadian Funds, Free On Board (FOB) Destination, and Freight Prepaid (Board locations). and shall be exclusive of Harmonized Sales Tax (HST) but shall include all materials, labour, equipment, disbursements, expenses, insurance, bonding, customs charges, freight, shipping and handling costs, travel costs and all other charges of every kind attributable to the Work and Services provided.

Bid Price includes Cash Allowance

Line Item	Description	Unit of Measure	Quantity	Bid Price *	Total
1	25-7748-RFT St. Andrew's Public School 3rd Floor Classroom Refinishing as per scope of work	Lump Sum	1		
Subtotal:					

Summary Table

Bid Form	Amount
Bid Price Form	
HST (13%)	\$ 0.00
Total Contract Amount:	

Bid Questions

Bidder Instructions

Answer all questions that are marked Mandatory. Reference information is provided below

Question #1 Reference

Bill S-211 - This enactment enacts the Fighting Against Forced Labour and Child Labour in Supply Chains Act, which imposes an obligation on certain government institutions and entities to ensure measures are taken to prevent and reduce the risk that forced labour or child labour is used by suppliers or in their supply chains. The Board principles align with Bill S-211.

Question #2 Reference

"Ontario Business" definition as per the BOBI Act:

- is a supplier, manufacturer or distribution of any business structure;
- conducts its activities on a permanent basis in Ontario; and
- has either
 - its headquarters or main office in Ontario, or
 - at least 250 full-time employees in Ontario at the time of the applicable procurement process.

Question #4 Reference

The Board will require General Contractors on the approved Roster List to have their IHSA - Certificate of Recognition (COR®) by January 2026. Although not mandatory for this bid opportunity, the Board requests bidders to respond to the question below YES or NO.

NOTE: By responding NO, you acknowledge the deadline requirement above.

Question #5 Reference

Is your company a U.S. business, as defined by the Ontario Treasury Board / Management Board of Cabinet (TB/MBC) as a supplier, manufacturer or distributor of any business structure (includes a sole proprietorship, partnership, corporation or other business structure) that: has its headquarters or main office located in the U.S., and has fewer than 250 full-time employees in Canada at the time of the applicable procurement process? Yes or No. (Comments are allowed.)

1. Confirm your organization will comply with this Act. YES or NO. If no, please explain.

2. Does your company qualify as an Ontario Business under the BOBI Act? YES or NO.

3. If you answered NO to Question #2 above, is your company a Canadian business? YES or NO

4. Does your company have a current IHSA - Certificate of Recognition (COR®)? - YES or NO

5. Is your company a U.S. business, as defined by the Ontario Treasury Board / Management Board of Cabinet (TB/MBC)?

Specifications

Bidder's Contact Information

A Site Supervisor and Project Manager, assigned to manage and supervise the Work, must be named in this form. Personnel will be subject to approval by the Board and cannot be changed without prior written approval from the Board.

A dedicated Site Supervisor is required full-time for this project. If your company is awarded more than one project/contract, a different Site Supervisor is required for each project. In the event of this situation, you have the option to name and include a resume for an alternative Site Supervisor at this time.

If providing an alternative Site Supervisor with your submission, it is understood, that the alternative Site Supervisor will only be reviewed if the first Site Supervisor has already been accepted and working on another WRDSB project.

Note: resumes are required to be uploaded in the document section. Optional for alternative Site Supervisor

.

Title	Name *	E-mail *	Cell Phone Number *	
Project Manager				*
Site Supervisor				*
Optional – Alternative 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.

Upload a resume for each person named in the Specification section.

- Project Manager - Resume * (mandatory)
- Site Supervisor - Resume * (mandatory)
- Optional - Alternative Site Supervisor - Resume (only if Site Supervisor #1 is assigned to another WRDSB project prior to this award) (optional)

BONDING UPLOAD SECTION

Refer to the Bonding Requirements Section of the Terms and Conditions.

Bonding is required if the project is equal to or greater than \$200,000.00. Note: The Bidding System has flagged these fields as mandatory. If your bid is less than \$200,000.00, please upload a pdf document stating: Not Applicable.

Bidders shall upload their electronically verifiable and enforceable (e-Bond) format for Bid Deposit Bond and Agreement to Bond separately in this section. If both Bonds are in the same pdf file, please upload it in both fields and indicate one is a "duplicate"

The date on the Bonds must be the Closing Date

Tender # and Project Title must be included on the Bonds

- Bid Deposit Bond * (mandatory)
- 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.		