

TECHNICAL SPECIFICATIONS

PROJECT : **St. Aloysius CES Addition and Renovations**

504 Connaught Street, Kitchener, ON L2C 1C2

CLIENT : Waterloo Catholic District School Board

PROJECT No. : 2025-06

DATE : **ISSUED FOR TENDER - April 9, 2026**

ARCHITECT :



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SPECIFICATIONS

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1.1 INVITATION

.1 Bid Call

.1 REGISTERED SUPPLIERS/BIDDERS

- All Bidders shall have a Bidding System Vendor account and be registered as a Plan Taker for this Bid opportunity, which will enable the Bidder to download the Bid Call Document, to receive Addenda email notifications and download all documents without the watermark “preview” on them.
- To ensure receipt of the latest information and updates via email regarding this bid, or if a Bidder has obtained this Bid Document from a third party, the onus is on the Bidder to create a Bidding System Vendor account and be register as a Plan Taker for the bid opportunity.

.2

ELECTRONIC BID SUBMISSIONS ONLY, shall be received by the Bidding System. Hardcopy submissions are not permitted.

Bidders are cautioned that the timing of their Bid Submission is based on when the Bid is RECEIVED by the Bidding System, not when a Bid is submitted, as Bid transmission can be delayed due to file transfer size, transmission speed, etc.

For the above reasons, it is recommended that sufficient time to complete your Bid Submission and to resolve any issues that may arise. The closing time and date shall be determined by the Bidding System’s web clock.

Bidders should contact bids&tenders support listed below, at least twenty-four (24) hours prior to the closing time and date, if they encounter any problems. The Bidding System will send a confirmation email to the Bidder advising that their bid was submitted successfully. If you do not receive a confirmation email, contact bids&tenders support at support@bidsandtenders.ca.

Late Bids are not permitted by the Bidding System.

.3

To ensure receipt of the latest information and updates via email regarding this bid, or if a Bidder has obtained this Bid Document from a third party, the onus is on the Bidder to create a Bidding System Vendor account and register as a Plan Taker for the bid opportunity.

Supplementary Form of Tender to be emailed to:
Stephen.butterworth@wcdsb.ca

.4

Submissions to the bidding system will be on or before **2:00:00pm Thursday May 7th, 2026**, local time and Followed by the Supplementary Form of Tender emailed to Stephen.butterworth@wcdsb.ca at **4:00:00 pm Thursday May 7th 2026** local time Instructions for tendering must be followed implicitly. Any Tender which does not comply with the *CCDC 2-2020 Stipulated Price Contract, Supplementary*

Conditions, as attached, and the Instructions to Bidders may be declared informal and may not be considered.

- .5 Stipulated sum tenders, submitted on the Form of Tender supplied, on the Work described in the following specifications and/or shown on the accompanying drawings, including all Addenda issued prior to the closing of Tender.
- .6 ALL BLANKS IN THE FORM OF TENDER, INCLUDING SUPPLEMENTAL FORM OF TENDER, SHALL BE FULLY COMPLETED OR THE TENDER MAY BE INVALIDATED. TENDERS NOT COMPLETED IN FULL, MAY, AT THE DISCRETION OF THE BOARD, BE REJECTED. IF A BLANK IS DEEMED TO BE NOT REQUIRED BY THE BIDDER, COMPLETE WITH A "NOT APPLICABLE (N/A)", "OWN FORCES", ETC.
- .7 Tenders shall be valid for sixty (60) Calendar Days from the date of closing above.
- .8 Tenders must note, and include, on a separate form, any "Separate Prices" requested by the Consultant; any "Alternate Prices to the Base Bid" requested by the Consultant; any "Supplementary Alternate Prices" proposed by the Bidder; as well as all Unit Prices indicated on the *Supplementary Form of Tender*. Tender award to be based on low bid as specified.
- .9 Tender award will be determined based on low Bid as specified.

1.2 INTENT

- .1 Intent of this Bid call is to obtain an offer to perform work to complete the construction of St. Aloysius CES located at 504 Connaught Street, Waterloo ON for a Stipulated Price contract, in accordance with Contract Documents.

1.3 CONTRACT/BID DOCUMENTS

- .1 Agreement Form
- .2 Definitions
 - .1 Contract Documents: Defined in the CCDC 2-2020 Stipulated Price Contract, Definitions.
 - .2 Bid Documents: Contract Documents supplemented with Instructions to Bidders, Project Information, Soils Investigation Data, Form of Tender, and Supplementary Form of Tender identified herein.
 - .3 Bid, Offer, or Bidding: Act of submitting an offer under seal or signed under witness.
 - .4 Bid Price: Monetary sum identified in Bid Form as an offer to perform work.
- .3 Availability
 - To obtain documents online please visit <https://wcdsb.bidsandtenders.ca/>. You can preview the bid documents with a Preview Watermark prior to registering for the opportunity.
 - .1 Documents are not provided in any other manner.
 - .2 Documents are made available only for purpose of obtaining offers for this project. Their use does not confer license or grant for other purposes.

- .3 A copy of soils investigation report may be found in Bid Documents
- .4 Examination
 - .1 Upon receipt of Bid Documents verify that documents are complete.
 - .2 Immediately notify, through the bidding system “Submit a Question”, upon finding discrepancies or omissions in Bid Documents.
- .5 Queries/Questions
 - .1 Questions related to this bid are to be submitted to the Purchasing representative through the Bidding System only by clicking on the “Submit a Question” button for this specific bid opportunity.

Purchasing Representative

Stephen Butterworth
Purchasing Officer
Waterloo Catholic District School Board

Email: Stephen.Butterworth@wcdsb.ca

Neither the Board nor the Board contact will be responsible for any verbal instructions or clarifications given during the Bidding process. As a result, verbal recollections of discussions, meetings, or telephone conversations will not be considered valid.

- .6 Addendums
 - .1 Bidders shall acknowledge receipt of any addenda through the Bidding System by checking the box for each addenda and any applicable attachment.

It is the responsibility of the Bidder to have received all Addenda that are issued. Bidders should check online at <https://wcdsb.bidsandtenders.ca/> prior to submitting their Bid and up until Bid closing time and date in the event additional addenda are issued.

If a Bidder submits their bid prior to the Bid closing time and date and addenda have been issued, the Bidding System shall WITHDRAW the Bid submission and the bid status will change to an INCOMPLETE STATUS and Withdraw the Bid. The Bidder can view this status change in the “MY BIDS” section of the Bidding System.

The Bidder is solely responsible to:

- make any required adjustments to their Bid; and
 - acknowledge the addenda; and
 - Ensure the re-submitted Bid is RECEIVED by the Bidding System no later than the stated bid closing time and date.
- .2 Clarifications requested by bidders must be received by the bidding system, not less than nine (9) days before date set for receipt of Bids. Reply will be in form of an addendum, a copy of which will be forwarded to known bidders no later than seven (7) working days before receipt of Bids

.7 Product/System Options

- .1 There are two opportunities for a Bidder to identify Alternates in the Bidder's Tender. The first method is to identify Alternates at the time of the Tender submission on the *Supplementary Form of Tender* to be attached to the Form of Tender. This document is to be entitled ALTERNATE PRICES TO BASE BID:
 - .1 Wherever possible or practical, the specifications are written on a "Base Bid" principle. When "Base Bid" product or service is identified, a number of "alternates" have been listed. The Bidder must tender on the "Base Bid" and indicate, on a separate sheet, Alternates and a credit to the Contract if one of the specified alternate supplier/manufacturer/installer or material/method of construction is being proposed by the Bidder. Only those identified Alternates in the Specification may be listed on the *Supplementary Form of Tender*. If the Specification identifies a "Base Bid" with a number of Alternates and the Bidder does not identify on the *Supplementary Form of Tender* any of the indicated Alternates with a credit, then the Contractor shall provide, in all instances, the "Base Bid" supplier/manufacturer/installer or material/method of construction.
 - .2 The Contractor shall accept full responsibility that a proposed Alternate will not exceed space requirements as indicated on the drawings and that coordination of the Contractor's own and related work and cost of installation is included in the Contractor's work. Approved alternate products or assemblies shall comply with all technical and design requirements specified in the "Base Bid". (E.g. materials, gauge, finish, colour, size, fit, mounting, strength, durability, operation and warranty.) If any additional design fee, either Architectural or Engineering, is required due to a change or substitution requested by the Contractor, the cost of such fee must be paid by the Contractor.
- .2 The second method is to identify alternates on the *Supplementary Form of Tender* and submitted, as requested by the Consultant, at the time of Tender. This document is to be entitled. SUPPLEMENTARY ALTERNATE PRICES:
 - .1 Mechanical and Electrical Alternates may be submitted on the *Supplementary Form of Tender*.
 - .2 If proposals for alternates (not already identified as alternates in the specification) are submitted by the Contractor to the Consultant during the tender period in sufficient time to allow for analysis and the issuance of an Addendum to include the proposals, then such proposal may be included in the Form of Tender under *Separate Prices*.
 - .3 Proposed alternates which are not covered by an Addendum and listed in the Form of Tender under *Separate Prices*, may be considered if the proposed entitled *Supplementary Alternate Prices* accompanies the *Supplementary Form of Tender* as a separate document on which the Alternate is completely specified and described, and on which is given the reason for substitution.
 - .4 Any proposed alternates or in lieu of prices will not necessarily be accepted.
 - .5 The Contractor shall accept full responsibility that a proposed Alternate will not exceed space requirements as indicated on the drawings and that

coordination of his own and related work and cost of installation is included in his work. Approved alternate products or assemblies shall comply with all technical and design requirements specified in the "Base Bid". (E.g. materials, gauge, finish, colour, size, fit, mounting, strength, durability, operation and warranty.) If any additional design fee, either Architectural or Engineering, is required due to a change or substitution requested by the Contractor, the cost of such fee must be paid by the Contractor.

- .6 Unless substitutions are submitted in this manner and subsequently accepted, provide products as specified.

1.4 OWNER

- .1 The Owner of the Project is:

WATERLOO CATHOLIC DISTRICT SCHOOL BOARD
35 Weber Street West, Unit A
Kitchener, Ontario N2H 3Z1
Phone: (519) 578-3660

1.5 CONSULTANT

The Architect on this Project is:

Grguric Architects Incorporated
28 King Street East, Unit B
Stoney Creek, ON L8G 1J8
Tel: 905-664-8735

1.6 SUB CONSULTANTS

- .1 The Structural Engineer for this Project is:

Doytch & Filo Engineering Inc.
5063 North Service Road, Suite 200
Burlington, ON L7L 5H6
Tel: 905-719-1482

5. The Roofing Consultant on this project is:

Tremco Roofing & Building Maintenance
80 Rankin Street Unit #2
Waterloo, ON N2V 1V9 Tel: 519-580-8244

- .2 The Mechanical Consultant on this Project is:

EXP Services Inc.
1595 Clark Boulevard
Brampton, ON L6T 4V1 Tel: 905-793-9800

- .3 The Electrical Consultant on this Project is:

EXP Services Inc.
1595 Clark Boulevard
Brampton, ON L6T 4V1 Tel: 905-793-9800

- .4 The Commissioning Agent on this Project is:

□ CFMS-West
2 Pelham Town Square, Unit 301
Fonthill, ON L0S 1E1 Tel: 905-304-3644

1.7 PREQUALIFIED GENERAL CONTRACTORS AND SPECIFIC TRADES

- .1 The following General Contractors and Specific Trades have been prequalified by the Board to bid on the work included in this Tender **as per the WCDSB – 2019-24 Mechanical, Electrical, and General Contractors.**

NOTE: This Tender can be tendered by **prequalified General Contractors and Specific Trades ONLY. Tenders received from non-prequalified General Contractors and Specific Trades will not be considered.**

GENERAL CONTRACTORS

CRD Construction Gateman Milloy Reid and Deleye Pre Eng Contractors STM Construction Melloul Blamey Gordner Construction Dakon Construction Elgin Contracting TRP Construction PM Contracting Devlan Construction Tambro Construction Sax Construction Percon Construction Everstrong Construction Spec Construction	Nith Valley Construction Norlon Builders Golden Gate Contracting Brook Restoration Harrington Construction Genpro Contracting J.R. Certus Harbridge and Cross Ritestart Ltd M J Dixon Construction AEC Developments Renokrew Zehr Levesque Inc. Aviero Hall Construction S.G. Cunningham

MECHANICAL TRADES

Aim Industrial Inc. Dependable Mechanical Sys. Arcadian Projects Jay Stewart Mechanical Conestoga Mechanical JTS Mechanical Roberts Onsite Dean Lane CEC Mechanical	L.J. Barton Mechanical Chamberlain Building Serv. Soan Mechanical Linde Mechanical JMR Electric Velocity Mechanical Brenner Mechanical Kittel Mechanical Superior Boiler Works

ELECTRICAL TRADES

Kraun Electric Inc. Aim Industrial Inc. Powerserve Inc.	Group L.J. Barton Mechanical Energy Network Services Superior Boiler Works

PHE Contractor Roberts Onsite T. Lloyd Electric Juno Electric Comtrade Ltd MJM Electric Trade Service Group	Chamberlain Building Serv. RBT Electrical CEC Services Ltd. JMR Electric B Safe Electric Ltd Arcadian Projects Millers Electric

**KINETIC NETWORK CONTRACTORS
 KINETIC SOLICITATION AND PROPOSAL NUMBER**

- .1 The Waterloo Catholic District School Board has issued a proposal as listed below to be procured through the Kinetic GPO, Tremco Roofing and Building Maintenance and Weatherproofing Technologies Canada Contract # RFSO 24-06 a pre-competed National Purchasing Agreement (GPO). The formal tender process has been satisfied as outlined in section .5.
 1. Customer Proposal Number RFSO 24-06 - 350780
- .2 The Waterloo Catholic District School Board invites Pre-qualified In Network Contractors for Roofing Services to bid for the supply of all labour, materials, equipment, and services required for this tender in accordance with the drawings and specifications prepared by Svedas Architects Inc.
- .3 Tremco Roofing and Building Maintenance and Weatherproofing Technologies Canada serves as Program Administrator for the Canadian Cooperative Contractor Network and the Kinetic Roofing Program.
- .4 In Network Contractors, having been pre-qualified and authorized by successfully submitting their company's credentials for inclusion in the Canadian Cooperative Contractor Network, may submit competitive proposals for the unique needs of the referenced building(s) outlined within the project documents.
- .5 The formal process of the Kinetic GPO Contract # RFSO 24-06 was publicly advertised on Merx, Biddingo, and Bonfire. Responses were evaluated and awarded using a competitive solicitation process consistent with Chapter 5 of the Canadian Free Trade Agreement (CFTA) and other international trade agreements, including the Canada-EU Comprehensive Economic and Trade Agreement (CETA), as well as the Broader Public Sector (BPS) Procurement Directive.
- .6 Competitive Proposals may be called, received, evaluated, accepted, and processed in accordance with the Board's Procurement and Purchasing By-Laws. By submitting a Proposal for this project, the Proposer agrees to be bound by the terms and conditions of such By-Laws and any amendments thereto, as fully as if it were incorporated herein. Any Contract resulting from this Kinetic GPO Competitive Proposal shall be governed by and interpreted in accordance with the laws of the Province of Ontario.

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- .7 Order of Precedence. The terms and conditions of the Board will take precedent over provisions stated in the Provisions of Kinetic GPO. Conflicts, if any, between Kinetic GPO Provisions and others stipulated within the project documents, require the proposer to adhere to the most stringent requirement published, as determined by the procurement official. The Provisions of Kinetic GPO will govern in absence of any terms and condition in the Specification. In addition, it is incumbent on the Contractor to make any subcontractor(s) performing under the Kinetic GPO contract aware of, and to provide subcontractor(s) with the terms and conditions of the Board as well as the Provisions of Kinetic GPO. The additional Provisions for Kinetic GPO are found attached to the Price Bid Form.
- .8 All project documents shall include the Kinetic GPO Contract Number RFSO 24-06 - 350780

PRE-QUALIFIED KINETIC NETWORK CONTRACTORS

Atlas Apex Roofing	D. Thackeray Roofing Company Ltd.
Eillen Roofing Inc.	Flynn Canada Ltd. (Cambridge)
Horizon Roofing Ltd.	Lafleche Roofing Ltd.
Provincial Roofing	Semple Gooder Roofing Corporation
Spinton Roofing Ltd.	Trio Roofing Systems Inc.
Triumph Roofing and Sheet Metal Inc.	Wm. Green Roofing Ltd.
Conestoga Roofing and Sheet Metal Ltd.	GRRRC Roofing
Goodmen Roofing and Sheet Metal	Pollard Enterprises Ltd.
Tectra Group Inc.	Nortex Roofing Ltd.
Roque Roofing Inc.	Nedlaw Roofing

1.8 SITE ASSESSMENT

- .1 Site Examination
- .1 Visit project site and surrounding area before submitting Bid.
- .2 Notwithstanding the responsibility, a Site Visit to project site has been arranged for General Contractors and their sub-trades as follows:
- .3 **Friday April 17th 2026 @ 8:00am at 504 Connaught Street, Kitchener**
- .4 **Meet at front entrance of school**
- .5 Before tendering, the Bidder shall examine the site, and the Reports prepared by separately engaged Consultants, bound into the Specifications for reference only, and shall ascertain the extent and nature of the materials it may be necessary, and shall be sure that the Bidder's determinations are made in accordance with the drawings and specifications and the Reports.
- .6 Proposals shall include the cost imposed by existing conditions and limitations of site and the accepted proposal shall be held to have included such costs. NO ALLOWANCE WILL BE MADE FOR FAILURE TO EXAMINE THE EXISTING SITE.

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- .7 The information shown on the drawings are furnished in good faith for the guidance of the Contractor, but shall in no way relieve the Contractor of the responsibility of ascertaining to the Contractor's own satisfaction the nature of all conditions at the site.

1.9 BID ENCLOSURES/REQUIREMENTS

.1 Security Deposit

- .1 Each tender shall be accompanied by a Bid Bond and Agreement to Bond in the most recent form approved by the Canadian Construction Association from a Surety Company, acceptable to the Board. The Bid Bond shall be in the amount of [...10% of Base Bid...], together with an Agreement to Bond. The Bid Bond must be valid for a minimum of sixty (60) Calendar Days from the closing date. Tenders not accompanied by a Bid Bond and Agreement to Bond will be declared informal.
- .2 This Bid Bond shall be forfeited if the bidder declines to enter into a formal contract in the amount tendered, or as adjusted according to the separate prices included in the tender, and/or to furnish, when called upon to do so, a Performance Bond. This Bid Bond shall be accompanied by an Agreement from the Surety Company that a 50 % Performance Bond and a 50 % Labour and Material Payment Bond will be issued to the Bidder if the Bidder is awarded the contract. The cost of the Bonds shall be included in the amount of the Tender. Refer to the *CCDC 2-2020 Stipulated Price Contract and the Supplementary Conditions, as attached*, for further information.
- .3 Retention and use of the Bid Bond, as outlined above, shall not be deemed a penalty, but a consideration to the Board for inviting and considering the Tender and as part payment for sustained damages and costs incurred by the Board, which shall be deemed to be the difference between the bid price of this Bidder and the bid price of the next lowest Bidder acceptable to the Board.
- .4 A Performance Bond, equal to 50 % of the contract price, shall be furnished through a Surety Company or Insurance Company approved by the Consultant and the Board according to terms and conditions acceptable to the Board and the Consultant.
- .5 On completion of the work, the Performance Bond shall remain in force as a MAINTENANCE BOND for a period of one (1) year from the date of acceptance of the building by the Board. It shall form a guarantee of workmanship and materials for the one (1) year period.
- .6 Use latest edition CCDC approved bond forms.

.2 Performance Assurance

- .1 The Bidder to whom the contract is awarded must properly sign the contract and furnish a satisfactory Performance Bond, Labour and Material Payment Bond, Insurance Certificate and Workers' Compensation Board Certificate within ten (10) Working Days of acceptance of the tender by the Board, or forfeit the Bid Bond.
- .2 Labour and Material Payment Bond, equal to 50 % of contract, to be provided within ten (10) Working Days, stating that the Board will not be held responsible if payment to subcontractors, as certified due by the Consultant, is not made by the General Contractor when due.

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- .3 Tenders must include all costs involved in having the contract **“Fit for Legal Occupancy and Substantial Performance” by August 2, 2027 and having the entire building Totally Completed by August 20, 2027**
- .4 Persons or firms submitting tender proposals shall be actually engaged as their recognized business in the lines of work required by the specifications, and shall be able to refer to work of a similar character which has been satisfactorily performed by them.
- .3 Fees for Changes in Work
- .1 It must be clearly understood that the Board cannot accept any price variation in the supply or installation of products or labour or materials from those submitted and carried by the Contractor at the time of tender. During the contract period, the Board will not be responsible for, or entertain any price increase in the cost of materials or labour carried in the tender amount.
- .2 The tender amount shall not include Harmonized Sales Taxes but shall include all other applicable excise taxes, custom duties, freight, exchange and all other charges in effect and known to come into effect during the construction work described in this Contract.
- .3 Unit Prices are exclusive of Harmonized Sales Taxes.
- .4 The successful Bidder must provide the Bidder's H.S.T. (Tax) Registration Number and each request for payment must show this number and the amount of H.S.T.(Tax) payable.
- .5 At the time of tender submission, include *Separate Prices* listed in the Supplemental Form of Tender for the identified items. Express each In Lieu of Price as a Credit or an Extra to the amount tendered. Contract Amount will be adjusted consistent with their acceptance or rejection by the Board. Separate Prices DO NOT include H.S.T.
- .4 Unit Prices
- .1 UNIT PRICES FOR ADDITIONAL WORK SHALL NOT EXCEED UNIT PRICES FOR DEDUCTED WORK BY MORE THAN 20%.
- .2 Unit prices must be submitted at time of Tender.
- .3 The Board reserves the right to accept or reject any or all of the unit prices prior to entering into a contract.
- .4 The Board reserves the right to negotiate any or all of the unit prices with the low Bid Contractor prior to signing a contract
- .5 Refer to *CCDC 2-2020 Part 6 CHANGES IN THE WORK* regarding valuation of changes not covered by Unit Prices.
- .5 Subcontractors
- .1 Bidders are required to submit the list of subcontractors. The list is to be submitted with tender, on the *Supplemental Form of Tender* included in the Contract Documents. The Bidder shall name in these lists the subcontractors proposed to perform the work under the contract. No substitutions to these lists shall be made without the written approval of the Consultants.

-
- .2 The selection of Subcontractors must be acceptable to the Board and to the Consultants. If the required substitution of a Subcontractor affects the sub-tender price, an adjustment will be made in the amount of the General Contract by the amount only of the difference in sub-tenders, without additional overhead or profit to the Contractor.
 - .3 If the Bidder proposes to do work with persons directly employed by the Bidder and not subcontract, then the Bidder shall insert the words "*Own Forces*" provided the Bidder can submit proof that the Bidder's forces have had previous experience in this field.
 - .4 Subcontractors shall be actually engaged as their own recognized business, in the line of work required by the specifications and shall carry out themselves the work which they are awarded by subcontract. They shall not be permitted to re-subcontract their work or portions thereof, to other contractors.
 - .6 Fair Wage and Labour
 - .1 Rate of wages, hours and conditions of work shall be in accordance with Provincial Codes and as generally recognized and accepted in the locality. Building mechanics and labourers resident in the district are to be employed where suitable.
 - .7 Discrepancies and Omissions
 - .1 Bidders, including subcontractors, finding specified items unavailable, finding discrepancies in, or omissions from, the drawings or specifications or other contract documents, or having any doubt as to the intent or meaning of any part thereof, shall at once notify the Consultant in writing, who will issue an Addendum to all bidders in explanation of the inquiry if necessary.
 - .2 All definitions, explanations, corrections or additional information will be issued by the Consultant during the time of bidding in the form of typewritten addenda and such addenda will be available to all Bidders. These shall become part of the contract documents and **must** be shown on the Form of Tender as having been received.
 - .3 NO ORAL INSTRUCTIONS WILL BE VALID.
 - .8 Bidding Assumptions
 - .1 All bids submitted, are assumed to be based upon the complete set of Bid Documents.
 - .9 Errors in Tender
 - .1 The Board shall not entertain requests for gratuitous payments arising from errors alleged to have been made in a tender which the Board has accepted
 - .10 Building Permit
 - .1 Building Permit has been applied for by the Consultant and shall be paid for by the Board.
 - .2 The Contractor must, however, pay all other necessary fees, deposits and charges related to Municipal, Provincial and Federal Requirements. The General Contractor is responsible for determining the amounts of these permits, fees, etc.
 - .11 Contract Documents

-
- .1 The Contract shall be subject to the Requirements of the *CCDC 2-2020* Stipulated Price Contract and the Supplementary Conditions, as attached. The successful Bidder must sign the *CCDC 2-2020* Stipulated Price Contract as amended by the Supplementary Conditions using this document and these specifications and drawings, within ten (10) Working Days of notification of award. Failure to do so may result in termination of the award. The Contractor shall not be entitled to any payment until this document is signed.
 - .2 All Contractors will be held to have examined and made themselves familiar with the various articles of these Standard Documents and shall be as binding for all sections of the following specifications as though written in full therein.

1.10 OFFER ACCEPTANCE/ REJECTION

- .1 Privilege and Waiver of Non-Compliance
 - .1 Notwithstanding anything elsewhere herein set out, the lowest or any proposal will not necessarily be accepted by the Board, and the Board reserves the right in its sole discretion to reject any and all proposals at any time or to accept any proposal which is considered advantageous by the Board. Proposals which are non-compliant with the requirements of this Tender, or which contain qualifying conditions, may be disqualified or the Board may waive any non-compliance with the Tender documents, and in its sole discretion, retain for consideration proposals which are non-conforming or non-compliant.
- .2 Acceptance of Offer
 - .1 It must be clearly understood that the final acceptance of this contract is subject to approvals of the Board and other bodies and these may delay final approval. There will be no adjustments in the tendered price for a period of sixty (60) Calendar Days from receipt of Tenders due to delays resulting from obtaining necessary approvals.
- .3 No Change in Pricing
 - .1 It must be clearly understood that the Board cannot accept any price variation in the supply or installation of products or labour or materials from those submitted and carried by the Contractor at the time of tender. During the contract period, the Board will not be responsible for, or entertain any price increase, in the cost of materials or labour carried in the tender amount for any reason, including acts of war or world events.
- .4 Withdrawal of Bids.
 - .1 Bidders may edit or withdraw their Bid Submission prior to the closing time and date. However, the Bidder is solely responsible to ensure the re-submitted bid is received by the Bidding System no later than the stated closing time and date.

Bids by hardcopy, telephone, email, or fax will not be accepted.

1.11 SPECIFICATION MANUAL AND INSPECTIONS

- .1 The Bidder must be aware that the Board has instructed the Consultant to prepare a painting specification based upon the *Painting Architectural*

Specification Manual prepared by the Ontario Painting Contractors' Association,
211 Consumers Road, Suite 305, Willowdale, ON, M2J 4G8

- .2 The Specification consists of three main components
 - .1 Evaluation and Choice of Systems – Surface Preparation
 - .2 Approved Product/Manufacture Listing – Specification Guide
 - .3 Inspection and Guarantee Program
 - .4 Refer to the specifications for the first two components listed above. The Inspection Procedure will be complied with in every respect by the successful General Contractor and the Painting Contractor as follows:
 - .1 Upon issuance of a subcontract to the Painting Contractor, the General Contractor shall fill out our “*Request for Assignment of an Inspector*” Form. The Inspection fee, which is a percentage charge of the painting subcontract price, will be paid from the *Allowances* identified in the General Instructions. Provide a copy of the properly executed Inspector Form to the Consultant and confirm the accuracy of the subcontractor's painting bid.
 - .5 The Form will contain the following information:
 - .1 Name of Contractor
 - .2 Name and Description of Project
 - .3 Name and Address of the Architect
 - .4 Job Location
 - .5 Project starting date
 - .6 Contract Price
 - .7 Commencement Date of painting.
 - .6 The Association will assign an Inspector to the project.
- .3 The Painting Contractor must advise the Association office of the actual starting date of painting. Painting shall not commence until the Association has been notified and the Inspector makes the initial site visit.
- .4 The Painting Contractor must supply the Inspector with a schedule of materials intended for use on the job at the commencement of the painting.
- .5 During the painting application the frequency of inspections will be sufficient to ensure adequate Quality Control procedures in accordance with the Painting *Architectural Specification Manual* and the Specifications.
- .6 The Inspector will use Interim Inspection Reports during the Project. One copy of each of these reports will be given to the Painting Contractor, one copy to the General Contractor, and two copies to the Association office, one of which will be forwarded to the Consultant. On completion of the job, the final Inspection Report will be made and routed as noted.
- .7 The Inspector will be required to check for proper preparation of surfaces, specified number of coats, as specified in the Specifications and drawings.
- .8 Any deficiencies must be corrected before the Guarantee is issued and final payment for painting made by the Board.

-
- .9 The Guarantee must cover making good any defects in painting and decorating due to faulty workmanship or defective materials supplied by the Painting and Decorating Subcontractor which appear during a two year period, following "substantial" completion of the Contract or the date of "Fit for Occupancy", whichever occurs first.

1.12 MILLWORK SPECIFICATIONS AND INSPECTIONS OR ANY OTHER SPECIFICATIONS REQUIRED BY THE APPROPRIATE CONSULTANTS

- .1
.1
.2
.1

1.13.0 COMPLIANCE WITH LAWS, REGULATION

- 1.13.1 In the performance of its obligations under the contract awarded (if any), the successful Respondent shall, at its own cost comply with, and ensure all persons for whom it is directly or indirectly responsible under this contract comply with all Federal, Provincial, County, City and Municipal laws, Acts, Codes and Regulations pertaining to the performance of the contract.
- 1.13.2 The successful Respondent shall obtain all necessary permits, licenses and fees required for the execution of the work and pay all fees required, including legal fees if any.

1.14.0 WCDSB POLICIES AND GUIDELINES

- 1.14.1 No work is to commence until an official purchase order, or award letter is received.
- 1.14.2 At all times while on the Board property, the successful Respondent, and all people for whom they are directly or indirectly responsible in law or under the contract, shall comply with all policies, rules and requirements of the Board.

END OF SECTION

1.1 TENDER INFORMATION

NAME OF BIDDER: _____

TENDER CLOSE: **Thursday May 7th 2026 at 2:00:00pm**

00:00:00] SUPPLEMENTAL TENDER FORM CLOSE:

Thursday May 7th 2026 at 4:00:00p.m.

NAME OF PROJECT: St. Aloysius CES Addition and Renovations

PROJECT NUMBER: RFT 2026-02

ELECTRONIC BID SUBMISSIONS ONLY, shall be received by the Bidding System.

Supplementary Form of Tender to be emailed to Stephen.butterworth@wcdsb.ca

1.2 ACKNOWLEDGEMENT RE EXAMINATION OF TENDER DOCUMENTS

- .1 Having carefully examined all of the drawings (Architectural, Structural, Mechanical, Electrical, Site Servicing and Landscape) and having carefully examined the Instructions to Bidders, the requirements of the *CCDC 2-2020 Stipulated Price Contract, as amended by the Supplementary Conditions, as attached*, and all of the attached Specifications; (Architectural, Structural, Mechanical, Electrical, Site Servicing and Landscape) including Addenda numbered as follows:

Addenda #.....to/and including Addenda#.....

and, having visited the sites, investigated and examined all conditions affecting the Work, including soil reports and surveys, and other reports as included in the Tender Documents, the undersigned Bidder makes the offers set out below.

1.3 CASH ALLOWANCES

- .1 All allowances specified under Section [01020] only amended as provided hereunder.

The Tender Amount includes the total Cash Allowance of \$500,000 not including Harmonized Sales Tax (HST). (*HST on Cash Allowance is not to be included in the Tender Amount*)

1.4 TENDER AMOUNT

- .1 The undersigned Bidder hereby offers to furnish all materials, labour, plant and equipment and to perform all duties and services called for by the ENTIRE WORK INCLUDING ALL TRADES for the Project named above for the stipulated sum of:

.....
(Written Value)

\$.....
(Numeric Value)

in lawful money of Canada, **excluding** Harmonized Sales Tax, but including all other applicable Excise Taxes, Custom Duties, Insurance's, Freight, Exchange and all other charges.

ALTERNATIVE PRICES:

1. TO UPGRADE FROM DOUBLE GLAZED TO TRIPLE GLAZED WINDOWS

- .1 **Fixed window** - typical unit:
- .1 E.g. Alumicor - RainBlade 2900 Series TrueLine, 146mm System Depth – **Triple Glazed Units**.
 - .2 Typical for punched openings fixed windows.
 - .3 Acceptable – Old Castle
- .2 **Horizontal Slider Operators:** - 100mm wide main frame depth, thermally broken frame and sash, **triple glazed**, side slider thermal break. 25mm insulating glass unit glazing. Maximum allowable air leakage of 0.06 (m³/hr) m⁻¹ @75 Pa and 23.30C (crack length = 3.20). CSA/CAN-A440 Ratings-A3,B7, C5. AAMA Rating – HC-55
- .3 **Curtain wall:**
- .1 Alumicor ThermaWall 2600 Series min. 160mm deep. **Triple Glazed Units**
 - .2 Old Castle Curtain Wall Systems

EXTRA COSTS: _____ +HST

1.5 TENDER VALIDITY

- .1 The undersigned Bidder is hereby submitting a valid Tender and will enter into the *CCDC 2-2020 Stipulated Price Contract, as amended by the Supplementary Conditions, as attached*, if we are notified in writing of our Tender acceptance by THE BOARD within sixty (60) calendar days from the closing of the Tender.

1.6 BONDING

- .1 The undersigned Bidder encloses a Bid Bond in the amount of [10]% made out in the name of WATERLOO CATHOLIC DISTRICT SCHOOL BOARD.
- .2 It is a condition of this Agreement that if the above mentioned Tender is accepted, application for a 50% Performance Bond and a 50% Labour and Material Payment Bond must be completed with undersigned within ten (10) days of acceptance of the tender related thereto, otherwise this Agreement shall be null and void.

1.7 CONSTRUCTION SCHEDULE

- .1 The undersigned Bidder solemnly undertakes, as an integral part of our proposal and tender to:
 - (a) Have the buildings "Fit for Occupancy" by **August 2nd 2027**
 - (b) Have all buildings and site work completed by **August 20th 2027**;
and **August 20th 2027**
 - (c) Have the Contract completed in its entirety by **August 20th 2027**.
- .2 The undersigned Bidder confirms that all appropriate costs, such as but not limited to winter heat, inclement weather protection and all overtime costs for all trades to meet the aforementioned schedule, have been included in our tender price to achieve this date.
- .3 The Bidder acknowledges and agrees that so long as a building permit is obtained and the Bidder is directed to commence Work within the sixty (60) calendar days following the Closing Date, even if such direction does not occur until the fifty-ninth (59th) day following the Closing Date, the Bidder shall not be entitled to a delay claim.
- .4 The undersigned Bidder acknowledges and agrees to comply with the terms and conditions of the Project Occupancy Requirements as outlined in the Supplementary Conditions, attached hereto

1.8 REQUIRED DOCUMENTS

- .1 If notified of the acceptance of this Tender via a Letter of Intent issued by the Board, the undersigned Bidder agrees to provide the prerequisite documentation within ten (10) days.

1.9 FEES FOR CHANGES IN THE WORK

- .1 The undersigned Bidder acknowledges and agrees that the fees referred to in *CCDC 2-2020 Stipulated Price Contract, as amended by the Supplementary Conditions, as attached*, will apply to changes in the Contract not covered by Unit Prices.

1.10 SUPPLEMENTARY FORM OF TENDER

- .1 The undersigned Bidder agrees to submit the *SUPPLEMENTARY FORM OF TENDER*, as attached, at Tender close, which shall including the following:
- BID AND COST BREAKDOWN
 - LIST OF SUBCONTRACTORS / SUPPLIERS / INSTALLERS
 - SEPARATE PRICES - REQUESTED BY CONSULTANTS
 - UNIT PRICES
 - ITEMIZED PRICES - REQUESTED BY CONSULTANTS
 - ALTERNATE PRICES TO BASE BID
 - LIST OF ALTERNATIVE BIDS SUBMITTED FOR CONSIDERATION

1.11 DECLARATION OF NO CONFLICT

- .1 The undersigned Bidder hereby declares that this Tender submission is made in good faith and without any connection, knowledge, comparison of figures, or arrangements with any other company, firm, or person making a Tender for the same work and is, in all respects, fair and without collusion with any other bidder for this Contract, and without fraud. The undersigned also represents and warrants that, to the best of the undersigned's knowledge and belief, no actual or potential conflict of interest exists with respect to the submission of the Tender or performance of the Contract other than those disclosed hereunder. The undersigned confirms that, where the Board discovers that the undersigned has failed to disclose all actual or potential conflicts of interest, the Board may disqualify the undersigned or terminate any Contract awarded to the undersigned pursuant to this Tender process. The undersigned understands that, for the purposes hereof, "conflict of interest" also includes:
- (a) in relation to the Tender process, the undersigned has an unfair advantage or engages in conduct, directly or indirectly, that may give the undersigned an unfair advantage, including:
- (i) having or having access to information in the preparation of the undersigned's proposal that is confidential to the Board and not available to other bidders;
communicating with any person with a view to influencing preferred treatment in the Tender process; or,
engaging in conduct that compromises or could be seen to compromise the integrity of the open and competitive process and render that process non-competitive and unfair; or,
- (b) in relation to the performance of its contractual obligations in a Board contract, the undersigned's other commitments, relationships or financial interests:
- (i) could or could not be perceived to exercise an improper influence over the objective, unbiased and impartial exercise of the Board's independent judgment; or,

- (ii) could or could not be perceived to compromise, impair or be incompatible with the effective performance of the undersigned's contractual obligations.

1.12 MUNICIPAL FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY ACT

- .1 This Tender and supporting documentation shall become the property of the Board. Information in a Tender is subject to potential disclosure to third parties after the award, in accordance with the provisions of the Municipal Freedom of Information and Protection of Privacy Act, R.S.O. 1990 ("MFOIPOP"). The Bidder acknowledges that any personal or confidential information which Bidders provide is being collected and will be used exclusively for the purposes of analyzing, evaluating and assessing Tenders submitted. Any information a Bidder wishes to identify as proprietary and have maintained as confidential, excluding unit pricing information as well as the total dollar value of the Tender, must be clearly identified as such, and any proposed restrictions on disclosure specified. For the purposes of a report to the Trustees of the Board, pricing information as well as the total dollar value of the Tender may be reported in a public report and will not be considered confidential. In addition, the Board may be ordered by the Information & Privacy Commissioner under the provisions of MFOIPOP to disclose additional information identified by a Bidder as proprietary and confidential.

1.13 LIMITATION OF LIABILITY

- .1 By submitting a Tender, the undersigned Bidder acknowledges and agrees that the Board will have no liability or obligation to any Tender except only that of the successful Bidder, if any, awarded the Contract by the Board, in its sole discretion. The Bidder also agrees that if the undersigned is not awarded the Contract, the Board shall be fully and forever released and discharged of all liability and obligations relating to this Request for Tender and all its submission procedures. All Bidders responding to this Request for Tender shall accept the decision of the Board as final and binding.

1.14 SIGNING OF TENDER

The undersigned Bidder is hereby submitting this Stipulated Sum Tender under a Corporate Seal or witnessed by an Individual.

PRINT COMPANY NAME: _____

PRINT ADDRESS OF COMPANY: _____

PRINT NAME OF CONTACT PERSON
REGARDING THIS TENDER: _____

CONTACT PERSON'S EMAIL: _____

PHONE NUMBER OF COMPANY: _____

SIGNATURE OF SIGNING OFFICER: _____

DATE: _____

PRINT NAME OF SIGNING OFFICER: _____

PRINT TITLE OF SIGNING OFFICER: _____

SIGNATURE OF WITNESS: _____

PRINT NAME OF WITNESS: _____

AFFIX CORPORATE SEAL (If no individual Witness):

END OF SECTION

Submit this Supplementary Form of Tender at the close of General Tenders.

1.1 TENDER INFORMATION

TENDER CLOSE: **Thursday May 7th 2026 at 2:00:00pm**

SUPPLEMENTAL TENDER FORM

CLOSE: **Thursday May 7th 2026 at 4:00:00pm**

NAME OF PROJECT: St. Aloysius CES Addition

PROJECT NUMBER: RFT 2026-02

Submission Email Address: stephen.butterworth@wcdsb.ca

1.2 SUPPLEMENTARY LIST OF SUBCONTRACTORS

- .1 I/We, the undersigned, propose to use the following Subcontractors and/or suppliers to perform work of this Contract, and I/we confirm that all have been investigated to confirm their reliability and competence to carry out the Work in accordance with the Contract Documents; and I/we agree that no changes from this may be made without the express written approval of the Board.

Extra costs to the Contract will not be considered for a Subcontractor/supplier substitution, regardless of the reason, except where a substitution is requested by the Owner.

Site Services _____

Asphalt Paving _____

Masonry _____

Structural Steel _____

Metal Fabrications _____

Cabinetwork _____

Sprayed Fireproofing _____

Roofing _____

Glazing _____

Gypsum Board and Acoustical Ceilings _____

Ceramic Tile _____

Resilient Flooring _____

Painting _____

Whiteboards and Tackboards _____
Gymnasium Equipment _____
Accessibility Lift _____
Electrical _____
Mechanical _____

1.3 ELECTRICAL SUB-CONTRACTORS

The Contractor shall state below the name of the Public Address, Security, Coordination Study, Computer Network, Life Safety Systems Commissioning Agent Sub-contractor he intends to use, which shall not be changed without the consent of the Consultant.

Co-ordination Study _____

Life Safety Systems Commissioning Agent _____

1.4 ELECTRICAL UNIT PRICES:

- .1 I/We enclose herewith Unit Prices, exclusive of applicable taxes, which are an integral part of the Bid. Unit prices are, in effect, for the duration of this Project's construction period, unit prices are exclusive of applicable taxes.
- .2 The following unit costs will apply to all additional or deleted work from the Contract and should include their proportionate share of all labour equipment, materials, accessories, profits, overhead and taxes for a job completely installed. Applications of unit prices will be to the net difference of quantities of individual products and materials in each Proposed Change or Change Order.
- .3 The unit prices will be used for additions and deletions. Credit rate for deletions shall be at 80% of original rates listed under sections 1.4, 1.5, 1.6, 1.7, 1.8, 1.9.
- .4 Conduit and Cable:

Supply and install the following conduit and cables including fastenings, clips, connectors, coupling boxes, etc. as required based on length as shown.

MORE WORK

.1	25MM EC/3500mm Length	\$ _____
.2	2 #12-12mm C/3500mm Length	\$ _____
.3	3 #12-12mm C/3500mm Length	\$ _____
.4	2 #10-19mm C/3500mm Length	\$ _____
.5	3 #10-19mm C/3500mm Length	\$ _____
.6	3 #8- 19mm C/3500mm Length	\$ _____

.5 Receptacles:

Supply and installation of one duplex receptacle, shall include the receptacle box, cover plate, 5000mm of conduit and wiring, including connection to adjacent receptacle and/or outlet box.

MORE WORK

- .1 Supply and installation of one
duplex receptacle

\$ _____

.6 Light Switches

Supply and installation of light switch shall include the switch box, cover plate, conduit, wiring and connection to box containing the lighting circuit.

MORE WORK

- .1 Supply and installation of one
347 volt light switch.

\$ _____

.7 Fire Alarm System:

MORE WORK

- .1 Supply and installation of one fire
alarm pull station, including conduits,
wiring and connections to the nearest
fire alarm pull station. (Base conduit
and wiring on 1500mm length).

\$ _____

- .2 Supply and installation of one fire
alarm cone speaker including conduit,
wiring and connections to nearest fire alarm
cone speaker. (Base conduit and wiring on
1500mm length).

\$ _____

.8 Lighting Fixtures:

Supply and installation of the following lighting fixtures. The supply and installation of lighting fixtures shall include the fixtures, flexible conduit, wiring and connection to nearest outlet box containing 347 and/or 120 volt circuits and the supply and installation of the lamps. (Base conduit and wiring on 4500mm length).

MORE WORK

- .1 Supply and installation of one type
'A' fixture

\$ _____

- .2 Supply and installation of one type
'B' fixture

\$ _____

- .3 Supply and installation of one type
'C' fixture

\$ _____

- .4 Supply and installation of one type
'E' fixture \$_____

1.5 LABOUR RATES

I/We enclose herewith Labour Rates which are an integral part of the Tender. Labour rates are in effect for the duration of this Project's construction period. The Owner is not obligated to accept Labour rates indicated.

.1 Mechanical Labour Rates

Labour at the following rates should be applied for additions or deletions to the work not covered by unit prices. The prices consist of salary, all agreed local union benefits. The rate quoted represents the net cost to the Contractor, exclusive of overhead and profit and applicable taxes.

- .1 Plumbing & Drainage Tradesmen \$_____ Per Hour
- .2 HVAC Piping Tradesman \$_____ Per Hour
- .3 Insulation Tradesmen \$_____ Per Hour
- .4 Sheet Metal Tradesmen
- .1 Shop \$_____ Per Hour
- .2 Field \$_____ Per Hour
- .5 (Other) \$_____ Per Hour
- .6 Sprinkler Pipefitter & Installer \$_____ Per Hour
- .7 Sprinkler Work Office/Engineer \$_____ Per Hour

1.6 SPRINKLER SUB-CONTRACTOR CASA MEMBERSHIP

Sprinkler Contractor shall be a paid member, and in good standing at time of Tender, of the Canadian Automatic Sprinkler Association. Attach membership certificate to this Supplementary Form of Tender.

- .1 Labour at the following rates shall be applied for additions or deletions to the work not covered by unit prices. The prices consist of salary, all agreed local union benefits. The rate quoted represents the net cost to the Contractor, exclusive of overhead and profit and applicable taxes.

- .1 Journeyman \$_____ Per Hour
- .2 Foreman \$_____ Per Hour

1.7 MECHANICAL MANUFACTURERS AND SUPPLIERS:

I/We enclose herewith a list of Manufacturers and Suppliers to the Mechanical Building Services which is an integral part of the Tender. We hereby agree that the Owner may select from any substitutes that we have offered in our Tender. Our Tender Price is based on the equipment/manufacturers indicated hereunder and we hereby agree that we will not alter the indicated equipment/manufacturers unless specifically authorized by the Owner.

I/We, the undersigned, have inserted below proposed substitutions and prices for the Owner's consideration.

I/We agree that:

- .1 all prices submitted take into consideration and allow for changes and adjustments in other work as may be necessary to provide a finished and functional result, unless specifically indicated otherwise;
- .2 alternative prices are for work which is not included in the Tender price listed on Form of Tender but which may be substituted by the Owner for work which is included (no price listed shall mean no change in cost);
- .3 and that the Board reserves the right to accept or reject any of the prices proposed hereunder;
- .4 prices listed hereunder do not include HST

	<u>Product/Equipment Specified</u>	<u>Proposed Substitution</u>	<u>Reduction in Contract Price</u>
.1	_____		\$ _____
.2	_____		\$ _____
.3	_____		\$ _____
.4	_____		\$ _____
.5	_____		\$ _____
.6	_____		\$ _____

Attach additional sheets and supporting documentation, if necessary.

1.8 STANDARDS OF MECHANICAL MATERIALS

BASE BID ITEM	ACCEPTABLE BASIS OF DESIGN	ALTERNATE
Pipe Hangers	Grinnell	Crane, Flamco, Unistrut
Mechanical Grooved Joints	Victaulic	Coupcu, Gruvlok
Unions	Crane	Grinnell, Dart
Expansion Joints	Flexonics	Amtrol, Hydroflex Tube Turn
Gate, Globe & Ball Valve	Crane	Jenkins, Toyo/R+W Kitz
Check Valves	Crane	Jenkins, Toyo/R+W Kitz
Plug Valves	DeZurick	NEO
Circuit Balancing Valves	Tour and Andersson	
Butterfly Valves	Crane	Jenkins, Centerline, Kitz, Toyo
Thermal Insulation	Fiberglas Canada	Manson, Knauf Johns-Manville
Pumps & Circulators (Except as noted)	S.A. Armstrong	ITT Fluids
Extended Shaft Coupling VIL Pumps	S.A. Armstrong	ITT Fluids
Strainers	Sarco	Crane, McAvity, Morrison Brass, Braukmann
Suction Guides	S.A. Armstrong	ITT Fluids, Victualic
Automatic Air Vents	Sarco	Amtrol, Braukmann S.A. Armstrong Terice

BASE BID ITEM	ACCEPTABLE BASIS OF DESIGN	ALTERNATE
Backflow Preventors	Watts	Braukmann, Zurn-Wilkins
Make-Up Assemblies	Watts	S.A. Armstrong, Bell & Gossett, Mueller, Singer
Gauges, Thermometers	Treice	Ashcroft, Weiss Weksler, Winters, Wika
Finned Tube Radiation and Convectors	Sigma	Dunham-Bush, Trane Engineered Air
Hot Water Unit Heaters and Cabinet Heaters	Sigma	Dunham-Bush, McQuay, Trane, Engineered Air
Steam Humidifiers	Engineered Air	Dri Steem
Hot Water Boilers	Boderus	
Prefabricated Chimneys	Van-Packer	Metal-Fab, Selkirk, ICC
Water Treatment	Aquarian	Alchem, Mogul, Culligan, Finnan
Fire Dampers	Controlled Air	Air Balance, Canadian Advanced Air, Ruskin
Louvre Insulated Blank-off Panels	Construction Specialties	
Air Terminal Devices (Diffusers, Registers, Grilles By-Pass Boxes)	E.H. Price	Nailor, Kruger, Carnes, Titus Tuttle & Bailey
Air Handling Unit	Engineered Air	McQuay, Trane, Haakon

BASE BID ITEM	ACCEPTABLE BASIS OF DESIGN	ALTERNATE
Heat Recovery Unit	Engineered Air	McQuay, Trane, Haakon
Fan Coil Units	Enviro-Tech	Trane, York
Misc. Fans	Cook	Carnes, Greenheck, ACME, Jenn-Air
Air Filters	Farr	Cambridge, Airguard, Vibron, A.A.F.
Filter Gauges	Dwyer	Airflow Developments (Canada) Ltd.
Dampers (Except low leakage)	Tamco	Johnson, Powers, Kerr Hunt, Honeywell, Barber-Coleman
Low Leakage Dampers	Tamco Series 9000	
Electrical Starters, Disconnects, MCC's, Alternator Panels	Square 'D'	Allen-Bradley, Klockner-Moeller
Noise and Vibration Control	Vibron	Korfund-Sampson, Vibro-Acoustics, Coolbreeze J.P. Environmental
Electric Pipe Tracing	Raychem	Serge-Baril
Trap Primers	PPP	
Plumbing Fixtures	American Standard	Crane, Kohler, Eljer
Floor Drains, Roof Drains, Cleanouts, Drainage Specialties	Zurn	Ancon J.R. Smith Mifab
Plumbing Trim	Chicago Faucets, Symmons	American Standard, Crane, Cambridge Brass

BASE BID ITEM	ACCEPTABLE BASIS OF DESIGN	ALTERNATE
Toilet Seats	Centoco	Beneke, Moldex, Olsonite
Domestic Water Heaters	Bradford-White	A.O. Smith, John Wood
Fire Extinguishers & Cabinets	National Fire Equipment	Wilson & Cousins
Washfountains	Bradley, Acorn	
S.S. Sinks	Aristaline	Kindred, Architectural Metal
Drinking Fountains	Haws	Sunroc
Emergency Eyewash	Haws	Bradley, Speakman
Mixing Valves	Symmons	Powers
Alarm Valves And Trim	Grinnell, Central	Reliable, Viking, Automatic, Victaulic
Siamese Connections	National Fire Equipment	Wilson & Cousins, Stelpro
Sprinkler Heads	Grinnell, Central	Reliable, Viking, Automatic, Victaulic
Equipment Cabinets	National Fire Equipment	Wilson & Cousins, Stelpro
Excess Pressure Pump	Albany	

1.9 ITEMIZED PRICES

These Itemized Prices will be used to identify the cost of components within the total Bid Sum required for the Owner's own internal auditing, exclusive of HST.

- .1 Supply and installation of Fire Alarm System complete with associated components, conduit and wiring as shown on drawing and described in specification.

_____ Dollars (\$_____)

- .2 Supply and installation of Dimming System complete with associated components, conduit and wiring as shown on drawing and described in specification.

_____ Dollars (\$_____)

- .3 Supply and installation of Security System complete with associated components, conduit and wiring as shown on drawing and described in specification.

_____ Dollars (\$_____)

- .4 Installation of Lighting Controls system (supply of Lighting Controls system is carried under the Cash Allowances)

_____ Dollars (\$_____)

1.10 SIGNING OF SUPPLEMENTARY FORM OF TENDER

PRINT COMPANY NAME: _____

PRINT NAME OF CONTACT PERSON
REGARDING THIS TENDER: _____

PRINT ADDRESS OF COMPANY: _____

PHONE NUMBER OF COMPANY: _____

PRINT NAME OF CONTACT PERSON
REGARDING THIS TENDER: _____

CONTACT PERSON'S EMAIL: _____

EMAIL ADDRESS SIGNING OFFICER: _____

SIGNATURE OF SIGNING OFFICER: _____

DATE: _____

PRINT NAME OF SIGNING OFFICER: _____

PRINT TITLE OF SIGNING OFFICER: _____

SIGNATURE OF WITNESS: _____

PRINT NAME OF WITNESS: _____

AFFIX CORPORATE SEAL (If no individual Witness):

END OF SECTION



Waterloo Catholic
District School Board

**SUPPLEMENTARY CONDITIONS
AMENDMENTS TO CCDC 2 – 2020
STIPULATED PRICE CONTRACT (Version May 2022)**

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**Waterloo Catholic
District School Board**

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

(the “Supplementary Conditions”)

**AGREEMENT, DEFINITIONS, AND
GENERAL CONDITIONS**



SUPPLEMENTARY CONDITIONS AMENDMENTS TO CCDC 2 – 2020 STIPULATED PRICE CONTRACT (Version May 2022)

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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

SC1 ARTICLE A-1 – THE WORK

SC1.1	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 20th day of August in the year 2027. .2 (if applicable) <i>Occupancy</i> by the 2nd day of August in the year 2027, and .3 <i>Ready-for-Takeover</i> by the 2nd day of August in the year 2027.”

SC2 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 Catholic District School Board's Supplementary Conditions & Amendments to Standard Construction Document CCDC2-2020 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) • Labour and Material Payment Bond (Form 31 – Labour and Material Payment Bond under Section 85.1 of the Act)

SC3 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>.”

SC4 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:



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		"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 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, 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."

SC5 *NEW* ARTICLE A-9 – CONFLICT OF INTEREST

SC5.1	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



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		<i>Subcontractors and Suppliers.</i> Consistent with this fundamental term of the <i>Contract</i>, the <i>Contractor</i> will not enter into any agreement or understanding with any <i>Subcontractor or 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."

SC6 *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>."

SC7 DEFINITIONS

Revisions to Existing Definitions		
SC7.1	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."



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SC7.2	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>) was commenced on or after October 1, 2019.”
SC7.3	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		
SC7.4	Adjudication	<u>Add</u> the following definition: “Adjudication <i>Adjudication</i> means construction dispute interim adjudication as defined under the <i>Construction Act</i>.”
SC7.5	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.”
SC7.6	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>.”
SC7.7	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>.”



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SC7.8	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)."
SC7.9	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."
SC7.10	EFT	<u>Add</u> the following definition: “EFT <i>EFT</i> has the definition given to it under GC 5.3.2."
SC7.11	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>."
SC7.12	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."
SC7.13	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."



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SC7.14	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 of any government or other public authority; acts of a public enemy; war; riot; sabotage; blockage; embargo; lightning; earthquake; adverse weather conditions but only if substantially beyond the weather norms of the <i>Place of the Work</i>; acts of God; or declared epidemic or pandemic outbreak or other public health emergency (e.g. SARS, COVID-19).”
SC7.15	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.”
SC7.16	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>.”
SC7.17	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.”
SC7.18	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.”
SC7.19	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.”



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SC7.20	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.”
SC7.21	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.”
SC7.22	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 Act, including the minimum requirements set out in Appendix “1” of the Supplementary Conditions.”
SC7.23	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.”
SC7.24	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 Contractor to the Owner or to the Owner’s representative or the Consultant requesting written clarification(s) and/or interpretation(s) of the Drawings and/or Specifications, Contract requirements and/or other pertinent information required to complete the Work of the Contract without applying for a change or changes to the Work.”
SC7.25	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 Contract.”

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

SC8 GC 1.1 CONTRACT DOCUMENTS

SC8.1	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 Contractor shall review the Contract Documents and shall report promptly to the Consultant any error, inconsistency, or omission the Contractor may discover. Such review by the Contractor shall be undertaken with the standard of care described in GC 3.13.1. Except for its obligation to make such review and report the result, the



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		<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.”
SC8.2	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.”
SC8.3	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>.
SC8.4	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>.”
SC8.5	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.”



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SC8.6	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.”
SC8.7	1.1.13	<u>Add</u> new paragraph 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>.”

SC9 GC 1.3 RIGHTS AND REMEDIES

SC9.1	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...”

SC10 *NEW* GC 1.5 EXAMINATION OF DOCUMENTS AND SITE

SC10.1	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



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		thereof more expensive in character, or more onerous to fulfil, than was contemplated or known when the tender was made or the <i>Contract</i> signed.
	1.5.2	The <i>Contractor</i> also declares that 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

SC11 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 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.”
SC11.2	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”.
SC11.3	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> .”

SC12 GC 2.3 REVIEW AND INSPECTION OF THE WORK

SC12.1	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.
SC12.2	2.3.3	<u>Delete</u> paragraph 2.3.3 in its entirety and <u>replace</u> it with the following: “2.3.3 The <i>Contractor</i> shall furnish promptly two copies to the <i>Consultant</i> and one copy to the <i>Owner</i> of all certificates and inspection reports relating to the <i>Work</i> .”



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SC12.3	2.3.4	In paragraph 2.3.4 <u>add</u> the word “review” after the word “inspections” in the first and second lines of paragraph 2.3.4.
SC12.4	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> ”.
SC12.5	2.3.8	<u>Add</u> a new paragraph 2.3.8 as follows: “2.3.8 The <i>Consultant</i> will conduct periodic reviews of the <i>Work</i> in progress, to determine general conformance with the requirements of the <i>Contract Documents</i> . Such reviews, or lack thereof, shall not give rise to any claims by the <i>Contractor</i> in connection with construction means, methods, techniques, sequences and procedures, nor in connection with construction safety at the <i>Place of Work</i> , responsibility for which belongs exclusively to the <i>Contractor</i> .”

SC13 GC 2.4 DEFECTIVE WORK

SC13.1	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> ”.
SC13.2	2.4.1.1 to 2.4.1.2	<u>Add</u> new paragraphs 2.4.1.1 and 2.4.1.2 as follows: “2.4.1.1 The <i>Contractor</i> shall rectify, in a manner acceptable to the <i>Consultant</i> and to the <i>Owner through the Consultant</i> all defective work and deficiencies throughout the <i>Work</i> , whether or not they are specifically identified by the <i>Consultant</i> . 2.4.1.2 The <i>Contractor</i> shall prioritize the correction of any defective work, which, in the sole discretion of the <i>Owner through the Consultant</i> , adversely affects the day to day operations of the <i>Owner</i> or which, in the sole discretion of the <i>Consultant</i> , adversely affects the progress of the <i>Work</i> .”
SC13.3	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.”
SC13.4	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

SC14 GC 3.1 CONTROL OF THE WORK

SC14.1	3.1.2	Amend paragraph 3.1.2 by <u>inserting</u> the words “Construction Schedule” after the word “sequences”.
SC14.2	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



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		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.”

SC15 GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

SC15.1	3.2.2.1	<u>Delete</u> subparagraph 3.2.2.1 and <u>replace</u> it with “[Intentionally left blank]”.
SC15.2	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>.”
SC15.3	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 semi-colon.
SC15.4	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>.”

SC16 GC 3.3 TEMPORARY WORK

SC16.1	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> ”.

SC17 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



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		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 and equipment, as are necessary on a best efforts basis to maintain progress under the accepted baseline <i>Construction Schedule</i> or revised construction schedule accepted by the <i>Owner</i> pursuant to GC 3.4 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>.”
SC17.2	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>.”

SC18 GC 3.5 SUPERVISION

SC18.1	3.5.1	<u>Delete</u> GC 3.5.1 and <u>replace</u> it with the following:



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		“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. .”
SC18.2	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>.”
SC18.3	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>.”

SC19 GC 3.6 SUBCONTRACTORS AND SUPPLIERS

SC19.1	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> .”
SC19.2	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”.
SC19.3	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



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		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.”
SC19.4	3.6.7, 3.6.8, 3.6.9 & 3.6.10	<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 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.”

SC20 GC 3.7 LABOUR AND PRODUCTS

SC20.1	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.
SC20.2	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.”
SC20.3	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:



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		“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>.”

SC21 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.”
SC21.2	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 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



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		periodically re-submit the <i>Shop Drawings</i> schedule to correspond to changes in the <i>Construction Schedule</i> ."
SC21.3	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."
SC21.4	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."

SC22 *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 relieves the <i>Contractor</i> from its responsibility to complete the <i>Contract</i> ."



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SC23 *NEW* GC 3.10 CUTTING AND REMEDIAL WORK

SC23.1	GC 3.10	Add 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.”

SC24 *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.”



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		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."

SC25 *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."

SC26 *NEW* GC 3.13 CONTRACTOR STANDARD OF CARE

SC26.1	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



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		.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

SC27 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."
SC27.2	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> ."
SC27.3	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."
SC27.4	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

SC28 GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

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

SC29 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."



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		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</i>; and .3 any other documents reasonably requested, in advance, by the <i>Owner</i> or the <i>Consultant</i>."
SC29.2	5.2.2	<u>Delete</u> GC 5.2.2 in its entirety and <u>replace</u> it with the following: "5.2.2 Applications for payment 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/WCDSB Lead</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: .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>;"



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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	5.2.6	In GC 5.2.6, <u>delete</u> the word “ <i>Consultant</i> ” and <u>replace</u> it with “ <i>Owner</i> ”.
SC29.7	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.”

SC30 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;



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		.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."
SC30.2	5.3.2 to 5.3.7	<u>Add</u> new paragraphs 5.3.2, 5.3.3, 5.3.4, 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 EFT 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



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		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."

SC31 GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK- AND PAYMENT OF HOLDBACK

SC31.1	GC 5.4	~~Delete~~ 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 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:



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		.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>.



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		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..

SC32 GC 5.5 FINAL PAYMENT

SC32.1	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.



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	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 backcharge 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 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



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		the foregoing, the <i>Owner</i> shall release the holdback in accordance with the <i>Construction Act</i> ."

SC33 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."

SC34 *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 establish a deficiency holdback, at the time of the review for <i>Substantial Performance of the Work</i>, based on a 200% dollar value of the deficiencies listed by the <i>Consultant</i>. 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>, 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

SC35 GC 6.1 OWNER'S RIGHT TO MAKE CHANGES

SC35.1	6.1.2	<u>Add</u> the following to the end of GC 6.1.2:



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		"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>."
SC35.2	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, 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 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>. 6.1.8 When a change in the <i>Work</i> is proposed or required, the <i>Contractor</i> shall within 10 calendar days submit to the <i>Consultant</i> for review a claim for a change in <i>Contract Price</i> and/or <i>Contract Time</i>. Should 10 calendar days be insufficient to prepare the submission, the <i>Contractor</i> shall within 5 calendar days, advise the <i>Consultant</i> in writing of the proposed date of submission of the claim. Claims submitted after the dates prescribed herein will not be considered."

SC36 GC 6.2

CHANGE ORDER

SC36.1	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>."



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SC36.2	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 for <i>Change Orders</i> with a value of \$0 to \$15,000 the total <i>Subcontractor/Supplier</i> mark-up including <i>Overhead</i> and profit shall be 10% and the total <i>Contractor</i> mark-up including overhead and profit shall be 5%. .2 for <i>Change Orders</i> in excess of \$15,000, the total <i>Subcontractor/Supplier</i> mark-up including <i>Overhead</i> and profit shall be 5% and the total <i>Contractor</i> mark-up including <i>Overhead</i> and profit shall be 3%. 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>.”

SC37 GC 6.3 CHANGE DIRECTIVE

SC37.1	6.3.6.1	<u>Amend</u> paragraph 6.3.6.1 by deleting the final period and adding the following: “.1 Ten percent (10%) for profit plus five percent (5%) for overhead on work by the <i>Contractor's</i> own forces up to the value of \$15,000 and five percent (5%) for profit plus three percent (3%) for <i>Overhead</i> on work by the <i>Contractor's</i> own forces in excess of \$15,000 and, .2 Ten percent (10%) fee on amounts paid to <i>Subcontractors</i> or <i>Suppliers</i> under subparagraph 6.3.7.9 for changes up to the value of \$15,000 and five percent (5%) on changes over \$15,000. Unless a <i>Subcontractor's</i> or <i>Supplier's</i> price has been approved by the <i>Owner</i>, the <i>Subcontractor</i> or <i>Supplier</i> shall be entitled to its actual net cost as determined in accordance with paragraph 6.3.7, plus ten percent (10%) for profit and five percent (5%) for <i>Overhead</i> on such actual net cost for changes in the <i>Work</i>, up to the value of \$15,000 and five percent



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		(5%) for profit and three percent (3%) for overhead on such actual net cost changes in the <i>Work</i> in excess of \$15,000.”
SC37.2	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.”
SC37.3	6.3.7.1(4)	<u>Delete</u> GC 6.3.7.1(4).
SC37.4	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;”
SC37.5	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> ;”.
SC37.6	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> ;”.
SC37.7	6.3.7.13	<u>Delete</u> GC 6.3.7.13.
SC37.8	6.3.7.15	<u>Delete</u> GC 6.3.7.15.
SC37.9	6.3.7.17	<u>Delete</u> GC 6.3.7.17 in its entirety including all subparagraphs.
SC37.10	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.”

SC38 GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

SC38.1	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> .”
SC38.2	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> or were concealed from discovery notwithstanding the conduct of the investigation described in paragraph 6.4.1, it shall provide the <i>Owner</i> and the <i>Consultant</i> with <i>Notice in Writing</i> no later than five (5) <i>Working Days</i> after the first observation of such conditions.” -and-



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		<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.”.
SC38.3	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> .”
SC38.4	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.”

SC39 GC 6.5 DELAYS

SC39.1	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).”
SC39.2	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).”
SC39.3	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> .”
SC39.4	6.5.4	<u>Delete</u> paragraph 6.5.4 in its entirety and <u>replace</u> it with the following:



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		“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.”
SC39.5	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</i>’s 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</i>’s 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</i>’s 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>Contract Time</i> or the reimbursement of the <i>Contractor</i>’s 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</i>’s efforts to maintain the <i>Construction Schedule</i>.”

PART 7 DEFAULT NOTICE

SC40 GC 7.1

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

SC40.1	7.1.2	In GC 7.1.2, delete 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”.
SC40.2	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



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		Work 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> ."
SC40.3	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>."
SC40.4	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>."
SC40.5	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"
SC40.6	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 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 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



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		suspension shall continue after such termination of the <i>Contract</i> or suspension of the <i>Work</i> ."

SC41 GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

SC41.1	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."
SC41.2	7.2.3.1	<u>Delete</u> subparagraph 7.2.3.1 in its entirety.
SC41.3	7.2.3.2	<u>Delete</u> subparagraph 7.2.3.2 in its entirety.
SC41.4	7.2.3.4	In subparagraph 7.2.3.4, <u>delete</u> the words "except for GC 5.1 - FINANCING INFORMATION REQUIRED OF THE OWNER".
SC41.5	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."
SC41.6	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



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		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

SC42 GC 8.1 AUTHORITY OF THE CONSULTANT

SC42.1	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."

SC43 GC 8.2 ADJUDICATION

SC43.13	8.2.2 to 8.2.7	<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: "8.2.2 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.



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		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



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		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> ."

SC44 GC 8.3 NEGOTIATION, MEDIATION AND ARBITRATION

SC44.1	8.3.1	Amend 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."
SC44.2	8.3.4	Amend 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> ".
SC44.3	8.3.6 to 8.3.9	Delete 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

SC45 GC 9.1 PROTECTION OF WORK AND PROPERTY

SC45.1	9.1.1.1	Delete 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;"
SC45.2	9.1.2	Delete 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."
SC45.3	9.1.5	Add new paragraph 9.1.5 as follows:



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		"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."

SC46 GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

SC46.1	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'."
SC46.2	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."
SC46.3	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,".
SC46.4	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,".
SC46.5	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>."

SC47 GC 9.4 CONSTRUCTION SAFETY

SC47.1	9.4.1	<u>Delete</u> GC 9.4.1 in its entirety and <u>replace</u> it with the following:



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		"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, Subcontractors</i> and <i>Suppliers</i>, the <i>Owner's</i> own forces, <i>Other Contractors</i>, and all persons attending the <i>Place of the Work</i> during the course of the <i>Project</i>."
SC47.2	9.4.2	Amend GC 9.4.2 by <u>adding</u> the following words after "and the <i>Contractor</i> ": ", <i>Subcontractors</i> and <i>Suppliers</i> ".
SC47.3	9.4.3	Amend GC 9.4.3 by <u>adding</u> the following words after "and the <i>Contractor</i> ": ", <i>Subcontractors</i> and <i>Suppliers</i> ".
SC47.4	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."
SC47.5	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>;"
SC47.6	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



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		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

SC48 GC 10.1 TAXES AND DUTIES

SC48.1	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>.”
SC48.2	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



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		<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."

SC49 GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

SC49.1	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>."
SC49.2	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>."
SC49.3	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".
SC49.4	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."

SC50 GC 10.4 WORKERS' COMPENSATION

SC50.1	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."

SC51 GC 11.1 INSURANCE

SC51.1	11.1	<u>Delete</u> entirety of GC 11.1 and <u>replace</u> with the following: "GC 11.1 INSURANCE



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		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 \$10,000,000.00 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 \$5,000,000.00 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 Where determined necessary by the <i>Contractor</i>, acting reasonably, aircraft and watercraft liability insurance will be obtained in accordance with the provisions of paragraph 11.1.3. Aircraft and watercraft liability insurance with respect to owned or non-owned aircraft and watercraft if used directly or indirectly in the performance of the <i>Work</i>, including use of <u>Additional</u> premises, shall be subject to limits of not less than \$2,000,000.00 inclusive per occurrence for bodily injury, death and damage to property, including loss of use thereof and limits of not less than \$2,000,000.00 for aircraft passenger hazard. Such insurance shall be in a form acceptable to the <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. .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



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		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



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		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>."

SC52 *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.



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		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 the receipt 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

SC53 GC 12.1 READY-FOR-TAKEOVER

SC53.1	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



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		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.”
SC53.2	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> .”
SC53.3	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.”
SC53.4	12.1.4	In GC 12.1.4, <u>delete</u> the words “list and” from the second line.
SC53.5	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.”
SC53.6	12.1.6	<u>Delete</u> GC 12.1.6 in its entirety.

SC54 GC 12.2 EARLY OCCUPANCY

SC54.1	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> , provided that such taking possession and use will not unduly interfere, in any material way, with the progress of the <i>Work</i> . The taking of possession or use of any such portion of the <i>Project</i> shall not be deemed to be the <i>Owner</i> ’s acknowledgement or acceptance of the <i>Work</i> or <i>Project</i> nor shall it relieve the <i>Contractor</i> of any of its obligations under the <i>Contract</i> . 12.2.2 Whether the <i>Project</i> contemplates <i>Work</i> by way of renovations in buildings which will be in use or be occupied during the course of the <i>Work</i> or where the <i>Project</i> involves <i>Work</i> that is adjacent to a structure which is in use or is occupied, the <i>Contractor</i> , without in any way limiting its responsibilities under this <i>Contract</i> , shall take all reasonable steps to avoid interference with fire exits, building access and egress, continuity of electric power and all other utilities, 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.”



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SC55 GC 12.3 WARRANTY

SC55.1	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...”
SC55.2	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> 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.”



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PART 13 INDEMNIFICATION AND WAIVER

SC56 GC 13.1 INDEMNIFICATION

SC56.1	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.”

SC57 GC 13.2 WAIVER OF CLAIMS

SC57.13	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.
SC57.14	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”.
SC57.15	13.2.1.2	In subparagraph 13.2.1.2 change the word “claims” to “Claims”.
SC57.16	13.2.1.3	<u>Delete</u> subparagraph 13.2.1.3 in its entirety.
SC57.17	13.2.1.4	In paragraph 13.2.1.4 change the word “claims” to “Claims”.
SC57.18	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”.



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SC57.19	13.2.3	<u>Delete</u> paragraph 13.2.3 in its entirety.
SC57.20	13.2.4	<u>Delete</u> paragraph 13.2.4 in its entirety.
SC57.21	13.2.5	<u>Delete</u> paragraph 13.2.5 in its entirety.
SC57.22	13.2.6	In paragraph 13.2.6 change the word “claim” to “Claim” in all instances in the paragraph.
SC57.23	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.
SC57.24	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.

SC58 *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>.”
SC58.2	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</i>’s 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



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		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>."



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APPENDIX 1
to the Supplementary Conditions

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

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

- .1 the written bill or request for payment must be in writing;
- .2 the *Contractor's* name and current address;
- .3 the *Contractor's* HST registration number;
- .4 the date the application for payment was prepared by the *Contractor*;
- .5 the period of time in which the services or materials were supplied to the *Owner*;
- .6 the purchase order number provided by the *Owner*;
- .7 reference to the provisions of the *Contract* under which payment is being sought (e.g. GC 5.3 –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;



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- (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.



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APPENDIX 2
to the Supplementary Conditions

SPECIAL SUPPLEMENTARY 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 12 inclusive, governing same, together with the changes with the new Construction Act is hereby made part of these Contract Documents, with the following amendments, additions and modifications:

SC59 ARTICLE A-10 TIME OF THE ESSENCE

SC59.1	Article A-10	<u>Delete</u> the header for Article A-10 being “ARTICLE A-10 TIME OF THE ESSENCE” and <u>replace</u> it with the following: “ ARTICLE A-10 TIME OF THE ESSENCE/LIQUIDATED DAMAGES ”.
SC59.2	Articles 10.3 to 10.7	<u>Insert</u> the following new Articles 10.3 to 10.7 as follows: 10.3 The <i>Contractor</i> further acknowledges that it understands that the <i>Owner</i> is responsible and must account to the students and staff of Waterloo Catholic District School Board. A failure by the <i>Contractor</i> to attain <i>Ready-for-Takeover</i> within the time prescribed in the Contract could result in damages to the <i>Owner</i> and to the students and staff of the Waterloo Catholic District School Board, which would be difficult or impractical to quantify but would nevertheless have a significant negative impact on the <i>Owner</i> and its ability to provide services the <i>Owner</i> is obliged to provide to the students and staff of the Waterloo Catholic District School Board. 10.4 Given the significance of the requirement for the Contractor to achieve <i>Ready-for-Takeover</i> , as described in Article A-10.3, without limiting the <i>Owner's</i> entitlement to any additional or other damages, if the <i>Contractor</i> fails to achieve <i>Ready-for-Takeover</i> by the time prescribed in Article A-1, the <i>Owner</i> will incur substantial damages and the extent of such damages shall be incapable or very difficult to accurately measure. Nonetheless, the parties acknowledge that as of the effective date of this <i>Contract</i> , the amount of liquidated damages set forth in Article A-10.5 below represents a good faith estimate on the part of the parties as to the actual potential damages that the <i>Owner</i> would suffer as a result of late completion of the <i>Project</i> . The amount of such liquidated damages does not include any penalty. Notwithstanding the foregoing, the <i>Owner</i> shall be entitled to the greater of (i) the liquidated damages as calculated pursuant to Article A-10.5, or (ii) in the event that the <i>Contractor</i> claims that this liquidated damages provision is invalid or unenforceable and the <i>Contractor</i> prevails on such a defence, the damages arising from the delay suffered by the <i>Owner</i> including, without limitation, consequential, special, incidental, and indirect damages, costs and expenses incurred or suffered by the <i>Owner</i> . 10.5 The <i>Contractor</i> shall pay to the <i>Owner</i> (or have deducted from <i>Contract</i> payments) liquidated damages of \$ [NTD: Include per diem rate] for each calendar day of delay beyond the prescribed date for <i>Ready-for-Takeover</i> , until <i>Ready-for-Takeover</i> is achieved and certified pursuant to the terms of the <i>Contract</i> . Liquidated damages will be assessed as incurred and reflected as deductions from amounts that may be due under any applications for payment pending at the time that such liquidated damages are assessed. 10.6 All liquidated damages that have not been deducted from payments prior to final payment shall be deducted from the final payment to be made by the <i>Owner</i> to the <i>Contractor</i> pursuant to GC 5.5 FINAL PAYMENT, and any amount of liquidated



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		damages in excess of the final payment amount, shall be paid by the <i>Contractor</i> to the <i>Owner</i>, within 30 calendar days following a written demand by the <i>Owner</i> for such payment.
	10.7	The liquidated damages payable under this Article A-10 are in addition to and without prejudice to any other remedy, action or any other alternative claim that may be available to the <i>Owner</i>.”

END OF AMENDMENTS TO CCDC 2 - 2020

1. General

1. Examine the place of the work for the existing conditions, matters and limitations relating to the scope of work such as but not exclusively: access and egress to and from the place of the work, adjacent buildings, obstructions, services, actual and proposed grade (levels), soils conditions, landscaping, parking areas, services, and rights and interests of other parties affecting the deployment of the place of the work and the work to be done thereon.
2. Be responsible to ensure that the subcontractors shall also conduct a thorough examination and have full knowledge of conditions at the place of the work affecting their work.
3. **Disclaimer:**
The following reports are not part of the Contract Documents prepared by the Architect or his subconsultants. The reports were not prepared by or under the supervision of the Architect. While every effort has been made to attempt to provide comprehensive information for the purposes of design and tendering, the Architect and his consultants claim no responsibility for the accuracy of the information contained in the report. Bidders must satisfy themselves in regard to all matters relating to conditions that may affect either the methods of construction or the cost of the work before submitting bids or commencing the work.

2. Site Investigation Data

1. A copy of the Consultants Limited Designated Substance Audit Report is provided under separate attachment.
Prepared by: MTE Consultants
File No: 64457-001 dated November 28, 2025
Total Pages: 41 pages
2. A copy of the Geotechnical Investigation Report is provided under separate attachment:
Prepared by: Chung & Vander Doelen Engineering Ltd.
File No: 2464 dated May 26, 2025
Total Pages: 64 pages

3. Property and Topographic Surveys

A copy of a property survey with respect to Place of the Work is being made available as part of the Bid Documents and attached with Architectural Drawings:
Titled: Plan of Survey of ALL OF LOTS 178, 179, 180, 181, PART OF LOT 182
REGISTERED PLAN 254, ALL OF BLOCK K, REGISTERED PLAN 1383, City of
Kitchener
Dated: May 13, 2025
Prepared by: Van Harten Land Surveyors – Engineers

End of Section



St. Aloysius CES Addition

Limited Designated Substance Audit Report

Project Location:

504 Connaught Street, Kitchener, ON

Prepared for:

Waterloo Catholic District School Board
480 Dutton Drive
Waterloo, ON N2L 4C6

Prepared by:

MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, ON N2B 3X9

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1.0 INTRODUCTION

1.1 Authorization

MTE Consultants Inc. (MTE) was retained by the Waterloo Catholic District School Board (WCDSB) to conduct a Limited Designated Substance Audit for the St. Aloysius Catholic Elementary School building located at 504 Connaught Street in Kitchener, Ontario.

The purpose of the audit was to identify the presence of Designated Substances within the building in accordance with Section 30 of the Occupational Health & Safety Act (OHSA), in advance of a building addition. This report meets the requirements of Section 30 of the OHSA and the requirements of Ontario Regulation (O. Reg.) 278/05.

2.0 SCOPE OF WORK

As requested by the Client, this assessment was limited to the proposed addition connection locations and adjacent areas of the existing building where impact may occur. One exterior concrete storage/mechanical structure located at the ball diamond was also included. Refer to the attached figure for the work areas. These areas are referred to in the following sections as the "Subject Areas".

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

- Review of existing or historical reports and documentation pertaining to Designated Substances within the building;
- Visual inspection of accessible locations within the Subject Area to identify the following suspect Designated Substances and Hazardous Building Materials:
 - Asbestos;
 - Lead;
 - Mercury;
 - Silica;
 - Mould growth;
 - Ozone Depleting Substances; and
 - Polychlorinated Biphenyls limited to fluorescent light ballasts.
- The following Designated Substances are not expected to be present due to the building use or in a form that is hazardous: Acrylonitrile, Arsenic, Benzene, Coke Oven Emissions, Ethylene Oxide, Isocyanates, and Vinyl Chloride;
- Collection of bulk building material samples suspected to contain asbestos;
- Collection of paint scrape samples suspected to contain lead;
- Submission of samples to an accredited and/or qualified laboratory;
- Interpretation of laboratory results; and
- Preparation of this report of findings and recommendations.

3.0 METHODOLOGY AND ASSESSMENT CRITERIA

This audit was conducted using visual and laboratory identification methods for the assessment of materials outlined in Section 2.0 and their corresponding location and use. Materials that are determined to be asbestos-containing materials (ACM) are further classified by their friability and condition. The areas outlined in Section 2.0 were inspected and limited to building components, materials and service connections. Notwithstanding that reasonable attempts were made to identify all Designated Substances, the possibility of concealed substances and material exists and may not become visible until substantial demolition has occurred and therefore are currently undocumented. All work was conducted in accordance with industry accepted methods and MTE Standard Operating Procedures and did not include the following:

- Materials indicated in this report as “Potentially Concealed”;
- Locations that may be hazardous to the surveyor (located at heights, electrical equipment, confined spaces);
- Where invasive inspection could cause consequential damage to the property or impair the integrity of the equipment, such as underground services or components of mechanical equipment;
- Locations concealed by building finishes that require substantial demolition or removal for access or determination of quantities (wall cavity, plumbing or electrical lines);
- Non-permanent items or personal contents, furnishings; and
- Settled dust or airborne agents unless otherwise stated.

4.0 ASSESSMENT AND RESULTS

An inspection of the building was conducted by MTE on November 12th, 19th, and 20th, 2025.

The proposed addition project is expected to disturb exterior doors, windows, building façade, roofing materials and associated structure, walls, associated hardware, sealants, and electrical/mechanical equipment within the Subject Area.

A description of the building and assessed finishes is provided below. Refer to Section 4.1 for a summary of findings.

Building Element	Description
Construction Date	1953 (Subject Area)
Addition Date(s)	1954, 1962, 1965, 2016
Levels	1
Exterior Finishes	Concrete Brick veneer and mortar Metal soffits Metal trim Sealants Silicon based sealants Flat roof system Cementitious hard texture coat

Building Element	Description
Building Structure	Wood Frame Concrete Concrete block
Building Insulations	Fibreglass batt
Mechanical Systems/Insulations	Gas fired hot water heating Roof mounted central air conditioning
	Parging on pipe fittings Fibreglass insulation on pipe straights Fiberglass insulation covered with Polyvinyl Chloride (PVC)
Electrical/Plumbing Systems	Fluorescent Light tubes, bulbs
Floor Finishes	Vinyl floor tiles Terrazzo
Wall Finishes	Brick Drywall Plaster Wood Concrete Block
Ceiling Finishes	Wood 2' x 4' Random fissure random pinhole ceiling tiles (2021 date stamp) 2' x 4' Pinhole ceiling tiles 1' x 1' Large and small pinhole ceiling tiles (2018 sample - Non ACM)

Storage/Mechanical Out building – Ball Diamond

Building Element	Description
Construction Date	Post 2000
Levels	1
Exterior Finishes	Concrete
Building Structure	Concrete
Building Insulations	Spray foam
Mechanical Insulations	Roxul insulation
Electrical	Fluorescent Light bulbs
Floor Finishes	Concrete
Wall Finishes	Wood
Ceiling Finishes	Concrete

As part of this assignment, MTE reviewed “2025 Asbestos Audit Update, St. Aloysius Catholic Elementary School” which was prepared by MTE Consultants and dated May 14, 2025. Review of this report indicated the following Designated Substances has been confirmed or suspected present within the Subject Area (main building):

Item	Material Description	Location
Confirmed ACM	Parged pipe fittings Grey Soft Caulking	Classroom 1000 (reportedly will not to be impacted by proposed project scope) Exterior
Suspect ACM	Roofing Materials Exterior Sealants on Windows/Doors Brick Mortar	Roof Exterior Exterior

4.1 Findings and Analytical Results

A summary of sampling locations and analytical results are included in **Appendix A** and is inclusive of historical sampling, as outlined in Section 4.0.

Laboratory certificates of analysis are included in **Appendix B**.

Figures of inspected areas are included in **Appendix C**.

A detailed summary of findings and recommended actions is provided in **Table 4.3 of Appendix A**.

4.1.1 Asbestos

Asbestos was used in building materials throughout the years with a peak usage in the 1950s and 1960s. While the manufacture of most ACM was banned in the 1970s, buildings constructed in the 1980s have the potential for ACM as well. In 1986, legislation limiting the use of asbestos in consumer products was introduced.

As part of this inspection, a total of 21 bulk samples of suspect ACM were submitted for asbestos analysis with a total of 22 analyses being performed. The difference between the number of samples submitted and the number of samples analysed can be a function of either the stop-positive method or the requirement of analyzing multiple layers, performed by the laboratory, from a single sample reported as additional samples or subsets of a sample.

Bulk samples were submitted for asbestos analysis to Paracel Laboratories Ltd. (Paracel), in Mississauga, Ontario. Paracel is certified under the Canadian Association of Laboratory Accreditation to perform asbestos analysis of bulk samples (accreditation number A3762). Laboratory analysis was conducted in accordance with the United States Environmental Protection Agency (USEPA), Test Method EPA/600-R-93/116: Method for the Determination of Asbestos in Bulk Building Materials, June, 1993 by Polarized Light Microscopy (PLM) as prescribed by O. Reg. 278/05.

Based on the building construction date and presence of concrete block walls, inspection was also conducted for vermiculite loose-fill insulation at wall penetrations.:

- Corridor, Concrete Block – no vermiculite identified; and
- Areas were excluded where concrete block was not present or concealed by building finishes, or where invasive inspection may either be hazardous to building occupants or cause significant aesthetic damage to building finishes.

Based on the laboratory results and visual identification, ACM was confirmed present at the time of the inspection.

4.1.2 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. In buildings constructed after 1990, these applications are no longer applicable outside of specialized uses (shielding for medical imaging etc.).

As part of this inspection, a total of 3 paint scrape samples were collected from surfaces and represent the paint colours which may be disturbed during the proposed project.

Samples were submitted for laboratory analysis by ASTM D3335-85A "Standard Method to Test for Low Concentrations of Lead in Paint by Atomic Absorption Spectrophotometry" following MOE Method E3470 Inductively Coupled Plasma Optical Emission Spectrometry to Paracel Laboratories Ltd., in Ottawa, Ontario. Paracel is accredited by the Canadian Association of Laboratory Accreditation to perform bulk lead analysis of paint.

Based on the laboratory results and visual identification, lead-containing materials were confirmed present at the time of the inspection. In addition, lead-containing solder on copper pipe connections or lead pipe gaskets may potentially be concealed in buried lines or wall cavities.

4.1.3 Mercury

Mercury is typically used in building service applications such as fluorescent light tubes, compact fluorescent bulbs, metal halide (sodium halide) lamp bulbs, and neon lights as a vapour. Mercury may exist in thermostats and pipe or mechanical equipment thermometers as a liquid. Mercury is presumed to be present in the above materials.

While sources of mercury may be present, no mercury-containing materials will be impacted by the proposed work.

4.1.4 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.

Building materials that are presumed to contain silica were visually identified at the time of the inspection.

4.1.5 Mould

No water damaged or mould growth impacted building materials were observed during the inspection.

4.1.6 Polychlorinated Biphenyls (PCB)

While sources of PCB's may be present in light ballasts, no PCB materials will be impacted by the proposed work.

4.1.7 Ozone-Depleting Substances (ODS)

ODS are chemical compounds that include chlorofluorocarbons (cfc's), hydrochlorofluorocarbons (hcf's), halons, methyl bromide, carbon tetrachloride, hydrobromofluorocarbons, chlorobromomethane, and methyl chloroform which are widely used

in cooling and refrigeration. The use of ODS is regulated under Ontario Regulation 463/10 *Ozone Depleting Substances and Other Halocarbons* Made under the Environmental Protection Act.

Building components presumed to contain ODS were identified at the time of the inspection and were recently damaged.

4.2 Conclusions and Recommendations

A detailed summary of recommended actions is provided in **Table 4.3 of Appendix A**.

In accordance with Section 30 of OHSA and Section 8 of O. Reg. 278/05, the Owner must provide a copy of this report to all contractors doing work at the building. The Owner must also provide a copy of this report to all prospective contractors.

Should any additional suspect Designated Substances be discovered during building renovation demolition, work in the vicinity should cease and the materials should not be disturbed until proper notification, testing and abatement instructions are provided. All waste generated as a result of any and all work at the Site must be handled, transported and disposed of in accordance with Ontario Regulation 347 made under the Environmental Protection Act and local by-laws. Based on the assessment findings and analytical results, the following abatement measures are presented. It should be noted that the recommended actions are the minimum required actions, as prescribed by the appropriate Acts, regulations, guidelines, standards, codes and general best practice measures.

4.2.1 Asbestos

ACMs were identified during the assessment. 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.

At the time of the audit, all ACM at the building was noted to be in good condition and no immediate remedial abatement action is required at this time.

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

ACM may be present in concealed locations and if construction, renovation, alteration, or maintenance activities are planned, invasive inspections of concealed locations for potential ACM must be performed prior to such activities.

Should any suspect ACM be discovered during the course of construction, renovation, alteration, or maintenance activities, work which disturbs the material must cease immediately. Suspect ACM must be treated as asbestos-containing or sampled prior to disturbance to assess the presence of asbestos.

There are no requirements under current legislation to remove ACM from a building simply because it is present. However, O. Reg. 278/05 requires that an Asbestos Management Program be implemented and maintained by the owner/employer where ACM is identified or suspected present.

4.2.2 Lead

Lead-containing paint and suspect lead-containing solder on plumbing connections were identified. As such special requirements for the management, handling and disposal of lead-containing materials by the owner, constructor, contractor, sub-contractors and workers apply. The abatement contractor should consult Environmental Abatement Council of Canada's (EACC) *Lead Guideline for Construction, Renovation, Maintenance or Repair (October 2014)* for the procedures and methods required to remove and dispose of lead-containing materials.

Low level lead-containing paint is also present and the following general procedures are recommended as a precautionary measure as per Environmental Abatement Council of Canada's (EACC) *Lead Guideline for Construction, Renovation, Maintenance or Repair (October 2014)*:

- General dust control;
- The washing of hands and face at on-site facilities;
- No smoking, eating, chewing gum or drinking in the work area; and
- No removal of painted surfaces by means of abrasive blasting.

4.2.3 Mercury

Mercury-containing materials were identified. All mercury containing materials or sources should be removed, intact, prior to any work which may disturb or damage them and cause worker exposure to mercury liquid and/or vapour.

On-site crushing of mercury-containing materials should not occur. Care should be taken to ensure safe storage of the above until recycling or disposal can be coordinated. Under current legislation, mercury waste requires handling and disposal in accordance with Ontario Regulation 490/09 of the OHSA and Ontario Regulation 347 of the Environmental Protection Act.

4.2.4 Silica

Silica is presumed to be present; therefore, special requirements for management and handling are required. The contractor should also consult MOL Occupational Health and Safety Branch's Guideline: *Silica on Construction Projects* (April 2011) for the procedures and methods required to remove and dispose of silica-containing materials.

4.2.5 Mould

No water damage or suspect mould growth was observed during the assessment therefore no special management and handling requirements are warranted.

It should be noted that the passage of time can alter conditions as they existed at the time the assessment and future water intrusions, water damage and associated mould growth may occur. Immediate response to future water intrusions by a professional consultant or restoration contractor is recommended.

4.2.6 Polychlorinated Biphenyls (PCB)

While sources of PCB's may be present in light ballasts, no PCB materials will be impacted by the proposed work.

4.2.7 Ozone Depleting Substances (ODS)

No building components presumed to contain ODS were identified and no special requirements for management, handling and disposal by the owner, constructor, contractor, sub-contractors and workers apply.

5.0 LIMITATIONS

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

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

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

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

All of which is respectfully submitted,

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https://mte85.sharepoint.com/sites/64457_001/Shared Documents/03- Reports/64457-001_2025-11-28_rpt_LDSA_St. Aloysius.docx

Appendix A

Tables

TABLE 2: BULK ASBESTOS SAMPLING SUMMARY

Sample #	Location	Material Description	Asbestos Content (%)	Fibre Type	Is Material ACM
2005 - Asbestos Audit Update					
WCDSB-SA-1000-WP1	1000	Wall Plaster	ND	-	No
WCDSB-SA-1000-WP2	1000	Wall Plaster	ND	-	No
WCDSB-SA-1000-WP3	1000	Wall Plaster	ND	-	No
WCDSB-SA-1008-CT	1008	Ceiling Tile	ND	-	No
WCDSB-SA-1003-CT	1003	Ceiling Tile	ND	-	No
WCDSB-SA-1017-PC1	1017	Ceiling Plaster	ND	-	No
WCDSB-SA-1017-PC2	1017	Ceiling Plaster	ND	-	No
WCDSB-SA-1017-PC3	1017	Ceiling Plaster	ND	-	No
WCDSB-SA-1015-WP1	1015	Wall Plaster	ND	-	No
WCDSB-SA-1015-WP2	1015	Wall Plaster	ND	-	No
WCDSB-SA-1015-WP3	1015	Wall Plaster	ND	-	No
WCDSB-SA-1025-ACT	1025	Ceiling Tile	ND	-	No
WCDSB-SA-1032-ACT	1032	Ceiling Tile	ND	-	No
WCDSB-SA-1026-ACT	1026	Ceiling Tile	ND	-	No
WCDSB-SA-1036-ACT	1036	Ceiling Tile	ND	-	No
WCDSB-SA-1033-WP1	1033	Wall Plaster	ND	-	No
WCDSB-SA-1033-WP2	1033	Wall Plaster	ND	-	No
WCDSB-SA-1033-WP3	1033	Wall Plaster	ND	-	No
2009 - Asbestos Audit Update					
WCDSB-SA-1003-CT-2	1003	1'x1' Large and Small Pinhole Ceiling Tile	8.1	Amosite	Yes
WCDSB-SA-1003-CT-3	1003	1'x1' Large and Small Pinhole Ceiling Tile	NA	Amosite	Yes
32961-ST.ALO-1013-2x2CT-S01A	1013	2'x2' Long Fissure Random Pinhole Ceiling Tile	0.25	Amosite	No
32961-ST.ALO-1013-2x2CT-S01B	1013	2'x2' Long Fissure Random Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1013-2x2CT-S01C	1013	2'x2' Long Fissure Random Pinhole Ceiling Tile	< MDL	Amosite	No
32961-ST.ALO-1032-2X2CT-S02A	1032	2'x2' Short Fissure Random Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1032-2X2CT-S02B	1032	2'x2' Short Fissure Random Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1032-2X2CT-S02C	1032	2'x2' Short Fissure Random Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1032-1X1CT-S03A	1032	1'x1' Medium Fissure Random Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1032-1X1CT-S03B	1032	1'x1' Medium Fissure Random Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1032-1X1CT-S03C	1032	1'x1' Medium Fissure Random Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1025-1X1CT-S04A	1025	1'x1' Small and Extra Small Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1025-1X1CT-S04B	1025	1'x1' Small and Extra Small Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1025-1X1CT-S04C	1025	1'x1' Small and Extra Small Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1035-1X1CT-S05A	1035	1'x1' Deep Fissure Random Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1035-1X1CT-S05B	1035	1'x1' Deep Fissure Random Pinhole Ceiling Tile	ND	-	No
32961-ST.ALO-1035-1X1CT-S05C	1035	1'x1' Deep Fissure Random Pinhole Ceiling Tile	ND	-	No
2013 - Designated Substance Audit					
32961-600-S01A	1013 (WR)	9" x 9" Green with White Fleck Vinyl Floor Tile	1.2	Chrysotile	Yes
32961-600-S01A	1013 (WR)	Mastic	3.1	Chrysotile	Yes
32961-600-S01B	1013 (WR)	9" x 9" Green with White Fleck Vinyl Floor Tile	NA	Chrysotile	Yes
32961-600-S01B	1013 (WR)	Mastic	NA	Chrysotile	Yes
32961-600-S01C	1013 (WR)	9" x 9" Green with White Fleck Vinyl Floor Tile	NA	Chrysotile	Yes
32961-600-S01C	1013 (WR)	Mastic	NA	Chrysotile	Yes
32961-600-S02A	1006	12" x 12" Blue Dense Fleck Vinyl Floor Tile	ND	-	No
32961-600-S02A	1006	Mastic	ND	-	No
32961-600-S02B	1005	12" x 12" Blue Dense Fleck Vinyl Floor Tile	ND	-	No
32961-600-S02B	1005	Mastic	ND	-	No
32961-600-S02C	1014	12" x 12" Blue Dense Fleck Vinyl Floor Tile	ND	-	No
32961-600-S02C	1014	Mastic	ND	-	No
32961-600-S03A	1003	1' x 1' Large and Small Pinhole Ceiling Tile	2.1	Amosite	Yes
32961-600-S04A	1009	9" x 9" Brown with Beige Streaks Vinyl Floor Tile	2.5	Chrysotile	Yes
32961-600-S04A	1009	Mastic	3.1	Chrysotile	Yes
32961-600-S04B	1009	9" x 9" Brown with Beige Streaks Vinyl Floor Tile	NA	Chrysotile	Yes
32961-600-S04B	1009	Mastic	NA	Chrysotile	Yes
32961-600-S04C	1009	9" x 9" Brown with Beige Streaks Vinyl Floor Tile	NA	Chrysotile	Yes
32961-600-S04C	1009	Mastic	NA	Chrysotile	Yes
32961-600-S05A	1014	Drywall Joint Compound	ND	-	No
32961-600-S05B	1015	Drywall Joint Compound	ND	-	No
32961-600-S05C	1015	Drywall Joint Compound	ND	-	No
32961-600-S06A	1021	9" x 9" Pink with Black Streaks Vinyl Floor Tile	1.3	Chrysotile	Yes
32961-600-S06A	1021	Mastic	2.4	Chrysotile	Yes
32961-600-S06B	1021	9" x 9" Pink with Black Streaks Vinyl Floor Tile	NA	Chrysotile	Yes

TABLE 2: BULK ASBESTOS SAMPLING SUMMARY

Sample #	Location	Material Description	Asbestos Content (%)	Fibre Type	Is Material ACM
32961-600-S06B	1021	Mastic	NA	Chrysotile	Yes
32961-600-S06C	1021	9" x 9" Pink with Black Streaks Vinyl Floor Tile	NA	Chrysotile	Yes
32961-600-S06C	1021	Mastic	NA	Chrysotile	Yes
32961-600-S07A	1021	9" x 9" Grey with Black Streaks Vinyl Floor Tile	1.5	Chrysotile	Yes
32961-600-S07A	1021	Mastic	2.1	Chrysotile	Yes
32961-600-S07B	1021	9" x 9" Grey with Black Streaks Vinyl Floor Tile	NA	Chrysotile	Yes
32961-600-S07B	1021	Mastic	NA	Chrysotile	Yes
32961-600-S07C	1021	9" x 9" Grey with Black Streaks Vinyl Floor Tile	NA	Chrysotile	Yes
32961-600-S07C	1021	Mastic	NA	Chrysotile	Yes
32961-600-S08A	1037	12" x 12" Green Dense Fleck Vinyl Floor Tile	ND	-	No
32961-600-S08A	1037	Mastic	ND	-	No
32961-600-S08B	1037	12" x 12" Green Dense Fleck Vinyl Floor Tile	ND	-	No
32961-600-S08B	1037	Mastic	ND	-	No
32961-600-S08C	1037	12" x 12" Green Dense Fleck Vinyl Floor Tile	ND	-	No
32961-600-S08C	1037	Mastic	ND	-	No
32961-600-S09A	1029	9" x 9" Olive Green with White Streaks Vinyl Floor Tile	3.5	Chrysotile	Yes
32961-600-S09A	1029	Mastic	3.1	Chrysotile	Yes
32961-600-S09B	1029	9" x 9" Olive Green with White Streaks Vinyl Floor Tile	NA	Chrysotile	Yes
32961-600-S09B	1029	Mastic	NA	Chrysotile	Yes
32961-600-S09C	1029	9" x 9" Olive Green with White Streaks Vinyl Floor Tile	NA	Chrysotile	Yes
32961-600-S09C	1029	Mastic	NA	Chrysotile	Yes
32961-600-S010A	1029	9" x 9" Beige with Brown Streaks Vinyl Floor Tile	1.5	Chrysotile	Yes
32961-600-S010A	1029	Mastic	3.1	Chrysotile	Yes
32961-600-S010B	1029	9" x 9" Beige with Brown Streaks Vinyl Floor Tile	NA	Chrysotile	Yes
32961-600-S010B	1029	Mastic	NA	Chrysotile	Yes
32961-600-S010C	1029	9" x 9" Beige with Brown Streaks Vinyl Floor Tile	NA	Chrysotile	Yes
32961-600-S010C	1029	Mastic	NA	Chrysotile	Yes
32961-600-S011A	Exterior	Window Caulking	ND	-	No
32961-600-S011B	Exterior	Window Caulking	ND	-	No
32961-600-S011C	Exterior	Window Caulking	ND	-	No
2015 - Asbestos Audit Update					
S01A	1032	Hard Texture Coat on Exterior Overhang	ND	Chrysotile	Yes
S01B	1032	Hard Texture Coat on Exterior Overhang	1	Chrysotile	Yes
S01C	1032	Hard Texture Coat on Exterior Overhang	NA	Chrysotile	Yes
S02A	1035	1'x1' Ceiling Tile Mastic	ND	-	No
S02B	1035	1'x1' Ceiling Tile Mastic	ND	-	No
S02C	1035	1'x1' Ceiling Tile Mastic	ND	-	No
S03A	1023	Pipe Fitting Insulation	60	Chrysotile	Yes
S03B	1023	Pipe Fitting Insulation	NA	Chrysotile	Yes
S03C	1023	Pipe Fitting Insulation	NA	Chrysotile	Yes
S04A	1032	Interior Door Caulking (Silver)	ND	-	No
S04B	1032	Interior Door Caulking (Silver)	ND	-	No
S04C	1032	Interior Door Caulking (Silver)	ND	-	No
S05A	Exterior	Exterior Window Sealant (Caulking) - Grey	ND	-	No
S05A	Exterior	Exterior Window Sealant (Caulking) - Brown	ND	-	No
S05A	Exterior	Exterior Window Sealant (Caulking) - Grey-Soft	3.1	Chrysotile	Yes
S05B	Exterior	Exterior Window Sealant (Caulking) - Grey	ND	-	No
S05B	Exterior	Exterior Window Sealant (Caulking) - Brown	ND	-	No
S05B	Exterior	Exterior Window Sealant (Caulking) - Grey-Soft	NA	Chrysotile	Yes
S05C	Exterior	Exterior Window Sealant (Caulking) - Grey	ND	-	No
S05C	Exterior	Exterior Window Sealant (Caulking) - Brown	ND	-	No
S05C	Exterior	Exterior Window Sealant (Caulking) - Grey-Soft	NA	Chrysotile	Yes
S06A	1009	Drywall Joint Compound	ND	-	No
S06B	1032	Drywall Joint Compound	ND	-	No
S06C	1029	Drywall Joint Compound	ND	-	No
2019 Asbestos Audit Update					
S01A	1017	Hard Texture Coat (1953 Original Building)	ND	-	No
S01B	1017	Hard Texture Coat (1953 Original Building)	ND	-	No
S01C	1017	Hard Texture Coat (1953 Original Building)	ND	-	No
S02A	1013	Drywall Joint Compound (1953 Original Building)	ND	-	No
S02B	1015	Drywall Joint Compound (1954 Addition)	ND	-	No
S02C	1029	Drywall Joint Compound (1965 Addition)	ND	-	No
2023 Asbestos Audit Update - Portables					
S05A	91203	12"x12" Vinyl Floor Tile – White with Dark Grey Fleck	ND	-	No
S05B	91203	12"x12" Vinyl Floor Tile – White with Dark Grey Fleck	ND	-	No
S05C	91203	12"x12" Vinyl Floor Tile – White with Dark Grey Fleck	ND	-	No

TABLE 2: BULK ASBESTOS SAMPLING SUMMARY

Sample #	Location	Material Description	Asbestos Content (%)	Fibre Type	Is Material ACM
2025 Limited Designated Substance Audit - Building Addition Project					
S01A	Corridor 1008	Craft paper - ceiling	ND	-	No
S01B	Corridor 1008	Craft paper - ceiling	ND	-	No
S01C	Corridor 1008	Craft paper - ceiling	ND	-	No
S02A	Corridor 1008	2x4 Ceiling Tile - Random Pinhole	ND	-	No
S02B	Corridor 1008	2x4 Ceiling Tile - Random Pinhole	ND	-	No
S02C	Corridor 1008	2x4 Ceiling Tile - Random Pinhole	ND	-	No
S03A	Exterior 1007	Black Window Pane Sealant	ND	-	No
S03B	Exterior 1007	Black Window Pane Sealant	ND	-	No
S03C	Exterior 1007	Black Window Pane Sealant	ND	-	No
S04A	Exterior corridor	Grey Sealant -	ND	-	No
S04B	Exterior Window Frame 1007	Grey Sealant -	ND	-	No
S04C	Exterior Sill Seam 1007	Grey Sealant -	ND	-	No
S05A	Exterior	Brick Mortar	ND	-	No
S05B	Exterior	Brick Mortar	ND	-	No
S05C	Exterior	Brick Mortar	ND	-	No
S06A	Exterior Corridor	Texture Coat Above Entrance	1%	Chrysotile	Yes
S06B	Exterior Corridor	Texture Coat Above Entrance	NA	Chrysotile	Yes
S06C	Exterior Corridor	Texture Coat Above Entrance	NA	Chrysotile	Yes
S07A	Roof	Top Built Up, Paper layers with tar	ND	-	No
S07B	Roof	Top Built Up, Paper layers with tar	ND	-	No
S07C	Roof	Top Built Up, Paper layers with tar	ND	-	No

NA: Not Analyzed due to stop positive method **ND:** No asbestos fibres detected above the laboratory minimum detection limit

A bulk material sample containing 0.5% or more asbestos therefore establishes that material as asbestos-containing. In accordance with Table 1 of O. Reg. 278/05, a minimum number of samples for the material to be classified as non asbestos. A homogeneous material is defined by O. Reg. 278/05 "as material that is uniform in colour and texture". Homogeneous samples are identified by an alphabetical suffix to sample names to represent multiple samples of a homogeneous material. When a homogeneous material is analysed it is determined to be asbestos-containing upon the first positive detection of asbestos equal to or greater than 0.5%. Subsequent samples of the same material are therefore not analysed. Some bulk samples are comprised of multiple layers and as such will require multiple analysis. In such cases each layer is isolated at the laboratory and analysed individually to determine asbestos content. As a result the laboratory may report additional samples beyond the submitted number of samples or include multiple analyses as subsets within a sample.

TABLE 4.2: LEAD IN PAINT SAMPLE SUMMARY TABLE

Sample #	Location	Colour	Material	Lead Content (ug/g)	Classification
LP1	Classroom 1000	White/Beige	Wall	2,910	LEAD-CONTAINING
LP2	Corridor 1008	White/Light Blue	Wall	856	LOW LEVEL LEAD-CONTAINING
LP3	Ice Rink Shack	Grey	Door/Frame	13	LOW LEVEL LEAD-CONTAINING
"<": The samples analysed reported concentrations of lead to be less than 1000 ug/g and are therefore classified as low level lead-containing. However, no lead concentrations were reported above the sample specific laboratory detection limit. As outlined in EACO's Lead Guideline for Construction, Renovation, Maintenance or Repair (October 2014), for the purpose of classifying surface coatings and mortars by laboratory analysis, any material containing lead at a concentration: • Greater than 0.5% by weight (5,000 µg/g, mg/kg, ppm) is considered lead-based; • Between 0.1 % and 0.5% by weight (1,000 to 5,000 µg/g, mg/kg, ppm) is considered lead-containing; or • Less than 0.1% (1,000 µg/g, mg/kg, ppm) is considered low level lead-containing.					

Table 4.3 - Summary of Designated Substances and Recommended Actions

St Aloysius Catholic Elementary School / 504 Connaught Avenue, Kitchener

Material	Location(s)	Material Description	Approximate Quantity	Photograph	Management Requirements If No Impacts to Material	Recommended Actions If Material Will Be Or Likely Be Impacted By Maintenance, Renovation, Construction or Demolition Activities
Asbestos Friable	MTE Room 1000	Insulation on Pipe Fittings	6	-	In place management in accordance with O. Reg. 278/05	Removal in accordance with O. Reg. 278/05 < 1m ² as a Type 2 or Type 2 Glove Bag Operation and for > 1m ² as a Glove Bag or Type 3 Operation
Asbestos Non-Friable	Exterior above entrance	Hard Texture Coat	3 m ²		In place management in accordance with O. Reg. 278/05	Removal in accordance with O. Reg. 278/05 Type 2 Operation – hand held tools only with dust suppression or power tools with HEPA vacuum attachment in conjunction with dust suppression OR Type 3 Operation – power tools with no dust suppression
Potentially Concealed Asbestos	Concealed Beneath Flooring Finishes	Floor Paper, Mastics and Levelling compounds	-	-	In place management in accordance with O. Reg. 278/05	Invasive sampling prior to maintenance/renovations/construction/demolition activities, if sampling confirms as ACM, removal in accordance with O. Reg. 278/05
Potentially Concealed Asbestos	Wall Cavities	Vermiculite Loose-Fill Insulation	-	-	In place management in accordance with O. Reg. 278/05	Invasive inspection prior to maintenance/renovations/construction/demolition activities, if present and sampling confirms as ACM, removal in accordance with O. Reg. 278/05
Potentially Concealed Asbestos	Concealed by Wall/Ceiling/Exterior Finishes	Asbestos Cement (Transite) Sheets	-	-	In place management in accordance with O. Reg. 278/05	Invasive inspection prior to maintenance/renovations/construction/demolition activities, if present and sampling confirms as ACM, removal in accordance with O. Reg. 278/05
Potentially Concealed Asbestos	Underground Piping Systems	Asbestos Cement (Transite) Pipe	-	-	In place management in accordance with O. Reg. 278/05	Invasive inspection prior to maintenance/renovations/construction/demolition activities, if present and sampling confirms as ACM, removal in accordance with O. Reg. 278/05
Lead-Containing Paint	Room 1000	White/beige Paint on Wall Surface	-		In place management in accordance with EACC's Lead Guideline	Removal as required prior to maintenance, renovations, construction or demolition activities in accordance with EACC's Lead Guideline as a: Class 1, Class 2A, Class 3A, or a Class 3B Operation

Table 4.3 - Summary of Designated Substances and Recommended Actions

St Aloysius Catholic Elementary School / 504 Connaught Avenue, Kitchener

Material	Location(s)	Material Description	Approximate Quantity	Photograph	Management Requirements If No Impacts to Material	Recommended Actions If Material Will Be Or Likely Be Impacted By Maintenance, Renovation, Construction or Demolition Activities
Low Level Lead-Containing Paint	Corridor	White/light blue Paint on Wall Surface	-	-	None	General hygiene procedures during renovation activities: • General dust control, • Washing of hands and face at on-site facilities, • No smoking, eating, chewing gum or drinking in the work area, • No abrasive blasting.
	Out Building	Grey Paint on Door/Frame	-	-		
Suspected Lead - Containing	Piping	Solder on copper pipe connections			In place management in accordance with EACC's Lead Guideline	Removal prior to renovation/demolition activities in accordance with EACC's Lead Guideline as a: Class 1 Operation
Potentially Concealed Lead	Concealed on Sanitary/Waste Lines	Lead Packed Pipe Gaskets	-	-	None	Invasive inspection prior to renovation or demolition activities. If confirmed present, removal in accordance with EACC's Lead Guideline as a: Class 1 Operation
Mercury	Throughout Interior of Building in Light Fixtures	Fluorescent Light Tubes and Bulbs in Light Fixtures	-		None	Intact removal and storage with no on-site crushing and disposal of materials to a licensed facility
Silica	Throughout Interior and Exterior of Building	Brick and Mortar, Terrazzo, Stucco, Concrete, Fill and Hardscaping	-	-	None	Conduct any work during renovation, demolition activities in accordance with the Ministry of Labour Guideline Silica on Construction Projects

Table 4.3 - Summary of Designated Substances and Recommended Actions						
St Aloysius Catholic Elementary School / 504 Connaught Avenue, Kitchener						
Material	Location(s)	Material Description	Approximate Quantity	Photograph	Management Requirements If No Impacts to Material	Recommended Actions If Material Will Be Or Likely Be Impacted By Maintenance, Renovation, Construction or Demolition Activities
PCBs	Light Fixtures Throughout	Fluorescent Light Ballasts in Light Fixtures	-		SOR/2008-273, the PCB Regulations, permits continued use of in-service PCB-containing light ballasts until the end of service life or until December 31, 2025	Assess Each Ballast Upon Removal From Service Appropriate storage and disposal of any PCB-containing ballasts in accordance with SOR/2008-273
ODS	Rooftop/piping	Rooftop Air Conditioning Unit(s) and system	-		None	Prior to the removal and disposal of equipment suspected of containing ODS, a licensed technician should be retained to drain and tag the equipment in a manner authorized under O. Reg. 463/10
Notes: 1) A copy of this report should be provided to all prospective contractors prior to quotation, in accordance with Section 30 of the Occupational Health and Safety Act. 2) Recommended actions are the minimum required actions, as prescribed by the appropriate Acts, regulations, guidelines, standards, codes and general best practice measures. Prior to demolition, the Contractor may choose to alter the approach and combine or break out sections of work. This is acceptable provided that the appropriate Acts, regulations, guidelines, standards and codes are followed and afford protection for the health and safety of workers, occupants and the public that is at least equal to the protection that would be provided by complying with the minimum requirements. 3) All waste generated is subject to characterization and disposal in accordance with Ontario Regulation 347.						

Appendix B

Laboratory Certificates of Analysis

Certificate of Analysis

MTE Consultants Inc. (Kitchener)

520 Bingemans Centre Dr.
Kitchener, ON N2B 3X9
Attn: Paul Semeniuk

Client PO: 64457-001
Project: 64457-001 St. Aloysius
Custody:

Report Date: 20-Nov-2025
Order Date: 14-Nov-2025

Order #: 2546506

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

Paracel ID	Client ID
2546506-01	S01A
2546506-02	S01B
2546506-03	S01C
2546506-04	S02A
2546506-05	S02B
2546506-06	S02C
2546506-07	S03A
2546506-08	S03B
2546506-09	S03C
2546506-10	S04A
2546506-11	S04B
2546506-12	S04C
2546506-13	S05A
2546506-14	S05B
2546506-15	S05C
2546506-16	S06A
2546506-17	S06B
2546506-18	S06C

Approved By:



Emma Diaz
Lab Manager

Any use of these results implies your agreement that our total liability in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis

Report Date: 20-Nov-2025

Client: MTE Consultants Inc. (Kitchener)

Order Date: 14-Nov-2025

Client PO: 64457-001

Project Description: 64457-001 St. Aloysius

Asbestos, PLM Visual Estimation MDL - 0.5%

Parcel ID	Sample Date	Colour	Description	Asbestos Detected	Material Identification	% Content
2546506-01	12-Nov-25	Brown	Craft Paper	No	Client ID: S01A	
					Material:	
					Cellulose	95
					Non-Fibers	5
2546506-02	12-Nov-25	Brown	Craft Paper	No	Client ID: S01B	
					Material:	
					Cellulose	95
					Non-Fibers	5
2546506-03	12-Nov-25	Brown	Craft Paper	No	Client ID: S01C	
					Material:	
					Cellulose	95
					Non-Fibers	5
2546506-04	12-Nov-25	Grey	Ceiling Tile	No	Client ID: S02A	
					Material:	
					Cellulose	40
					MMVF	30
					Non-Fibers	30
2546506-05	12-Nov-25	Grey	Ceiling Tile	No	Client ID: S02B	
					Material:	
					Cellulose	40
					MMVF	30
					Non-Fibers	30
2546506-06	12-Nov-25	Grey	Ceiling Tile	No	Client ID: S02C	
					Material:	
					Cellulose	40
					MMVF	30
					Non-Fibers	30
2546506-07	12-Nov-25	Black	Sealant	No	Client ID: S03A	
					Material:	
					Non-Fibers	100
2546506-08	12-Nov-25	Black	Sealant	No	Client ID: S03B	
					Material:	
					Non-Fibers	100
2546506-09	12-Nov-25	Black	Sealant	No	Client ID: S03C	
					Material:	
					Non-Fibers	100
2546506-10	12-Nov-25	Grey	Sealant	No	Client ID: S04A	
					Material:	
					Non-Fibers	100

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

Client PO: 64457-001

Report Date: 20-Nov-2025

Order Date: 14-Nov-2025

Project Description: 64457-001 St. Aloysius

Asbestos, PLM Visual Estimation MDL - 0.5%

Parcel ID	Sample Date	Colour	Description	Asbestos Detected	Material Identification	% Content
2546506-11	12-Nov-25	Grey	Sealant	No	Client ID: S04B Material: Non-Fibers	100
2546506-12	12-Nov-25	Grey	Sealant	No	Client ID: S04C Material: Non-Fibers	100
2546506-13	12-Nov-25	Grey	Brick Mortar	No	Client ID: S05A Material: Non-Fibers	100
2546506-14	12-Nov-25	Grey	Brick Mortar	No	Client ID: S05B Material: Non-Fibers	100
2546506-15	12-Nov-25	Grey	Brick Mortar	No	Client ID: S05C Material: Non-Fibers	100
2546506-16	12-Nov-25	White	Texture Coat	Yes	Client ID: S06A Material: Chrysotile Non-Fibers	1 99
2546506-17	12-Nov-25	White	Texture Coat		Client ID: S06B Material: not analyzed, positive stop	
2546506-18	12-Nov-25	White	Texture Coat		Client ID: S06C Material: not analyzed, positive stop	

Total Analyses = 16

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	Lab Accreditation	Analysis Date
Asbestos, PLM Visual Estimation	EPA 600/R-93/116	1 - Mississauga	CALA 3762	20-Nov-25

Mississauga Lab: 15 - 6800 Kitimat Rd Mississauga, Ontario, L5N 5M1

Certificate of Analysis

Report Date: 20-Nov-2025

Client: MTE Consultants Inc. (Kitchener)

Order Date: 14-Nov-2025

Client PO: 64457-001

Project Description: 64457-001 St. Aloysius

Work Order Revisions | Comments

None

Other Report Notes

Samples were analysed as received. Paracel is not responsible for inherent analytical limitations. Analytes in bold indicate asbestos mineral content. All samples where asbestos is detected below 1% include quantity verification with additional analysis steps including gravimetric reduction and/or point counting. Problem matrices, such as those high in cellulose and/or non-friable organically bound materials, routinely include additional gravimetric reduction to remove interfering fibers/binders. Content denoted as '<MDL' indicates trace asbestos was observed below the noted detection limit, but could not be accurately quantified. Content denoted as 'Present' indicates that only a qualitative analysis was possible as a consequence of the sample matrix. Sample collection according to the regulation/method recommendations is the responsibility of the client.

MMVF: Man Made Vitreous Fibers: Fiberglass, Mineral Wool, Rockwool, Glasswool



Client Name: MTE Consultants Inc.	Project Reference: St Aloysius	Turnaround Time: ☐ Immediate ☐ 1 Day -EOD ☐ 4 Hour ☐ 2 Day -EOD ☐ 24 Hour ☐ 3 Day -EOD ☒ Regular
Contact Name: Paul Semeniuk	Quote #: 24-042 MTE Standing Offer	
Address: 520 Bingmans Centre Drive Kitchener ON N2B 3X9	PO #: 64457-001	
Telephone: 519-743-6500	Email Address: psemeniuk@mte85.com zhopkins@mte85.com jscozzafava@mte85.com	
Date Required:		

ASBESTOS & MOLD ANALYSIS

Matrix: ☐ Air ☒ Bulk ☐ Tape Lift ☐ Swab ☐ Other Regulatory Guideline: ☒ ON ☐ QC ☐ AB ☐ SK ☐ Other:

Analyses: ☐ Microscopic Mold ☐ Culturable Mold ☐ Bacteria GRAM ☐ PCM Asbestos ☒ PLM Asbestos ☐ Chatfield Asbestos ☐ TEM Asbestos

Parcel Order Number: 2546506		Asbestos - Bulk		Sampling Date	Air Volume (L)	Analysis Required
Sample ID		Materials to Be Analyzed * If Positive Stop requested, indicate if by Sample (SMP) or Material (MAT)	POS STOP SMP MAT			
1	See Attached		☐ ☐			
2			☐ ☐			
3			☐ ☐			
4			☐ ☐			
5			☐ ☐			
6			☐ ☐			
7			☐ ☐			
8			☐ ☐			
9			☐ ☐			
10			☐ ☐			

* If left blank, all lab identified distinct materials in each sample will be analyzed and reported separately, as per EPA 600/R-93/116. Additional charges will apply.
Manufactured multi-layered building materials will be analyzed as one sample, unless requested by client.

Comments:	Method of Delivery: Truck

Submitting adequate sample volume is the responsibility of the client. Refer to the reverse of this CoC for recommended sample volumes. Signing this CoC authorizes Paracel to complete the analysis on the sample as submitted.

Relinquished By (Sign):	Received at Depot:	Received at Lab:	Verified By:
Relinquished By (Print): Jason Scozzafava			
Date/Time: November 13, 2025	Date/Time:	Date/Time: Nov 14/25	Date/Time: Nov 14/25

12:30

14:03

PARACEL LABORATORIES LTD. ASBESTOS ANALYSIS						
Sample ID	Location	Matrix Description	Sampling Date	Positive Stop (Y/N)	Layered? (Y/N)	Layer Descriptions
S01A	Corridor 1008	Craft paper - ceiling	11/12/2025	y	n	
S01B	Corridor 1008	Craft paper - ceiling	11/12/2025	y	n	
S01C	Corridor 1008	Craft paper - ceiling	11/12/2025	y	n	
S02A	Corridor 1008	2x4 Ceiling Tile - Random Pinhole	11/12/2025	y	n	
S02B	Corridor 1008	2x4 Ceiling Tile - Random Pinhole	11/12/2025	y	n	
S02C	Corridor 1008	2x4 Ceiling Tile - Random Pinhole	11/12/2025	y	n	
S03A	Exterior 1007	Black Window Pane Sealant	11/12/2025	y	n	
S03B	Exterior 1007	Black Window Pane Sealant	11/12/2025	y	n	
S03C	Exterior 1007	Black Window Pane Sealant	11/12/2025	y	n	
S04A	Exterior corridor	Grey Sealant -	11/12/2025	y	n	
S04B	Exterior Window Frame 1007	Grey Sealant -	11/12/2025	y	n	
S04C	Exterior Sill Seam 1007	Grey Sealant -	11/12/2025	y	n	
S05A	Exterior	Brick Mortar	11/12/2025	y	n	
S05B	Exterior	Brick Mortar	11/12/2025	y	n	
S05C	Exterior	Brick Mortar	11/12/2025	y	n	
S06A	Exterior Corridor	Texture Coat Above Entrance	11/12/2025	y	n	
S06B	Exterior Corridor	Texture Coat Above Entrance	11/12/2025	y	n	
S06C	Exterior Corridor	Texture Coat Above Entrance	11/12/2025	y	n	

2546506



AN
Nov 14/25
1230

ym
Nov 14/25
1403

Certificate of Analysis

MTE Consultants Inc. (Kitchener)

520 Bingemans Centre Dr.
Kitchener, ON N2B 3X9
Attn: Paul Semeniuk

Client PO: 64457-001

Project: 64457-001 - St Aloysius

Custody:

Report Date: 25-Nov-2025

Order Date: 20-Nov-2025

Order #: 2547415

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

Paracel ID	Client ID
2547415-01.1	S07A
2547415-01.2	S07A
2547415-02.1	S07B
2547415-02.2	S07B
2547415-03.1	S07C
2547415-03.2	S07C

Approved By:



Emma Diaz

Lab Manager

Certificate of Analysis

Report Date: 25-Nov-2025

Client: MTE Consultants Inc. (Kitchener)

Order Date: 20-Nov-2025

Client PO: 64457-001

Project Description: 64457-001 - St Aloysius

Asbestos, PLM Visual Estimation MDL - 0.5%

Parcel ID	Sample Date	Colour	Description	Asbestos Detected	Material Identification	% Content
2547415-01.1	19-Nov-25	Black/Yellow	Tar/Foam	No	Client ID: S07A	
					Material:	[AS-LR-NA]
					Cellulose	10
					MMVF	10
2547415-01.2	19-Nov-25	Black/Brown	Tar/Cellulose	No	Client ID: S07A	
					Material:	[AS-LR-NA]
					Cellulose	20
					MMVF	10
2547415-02.1	19-Nov-25	Black	Tar	No	Client ID: S07B	
					Material:	[AS-LR-NA]
					Cellulose	10
					MMVF	10
2547415-02.2	19-Nov-25	Black/Brown	Tar/Cellulose	No	Client ID: S07B	
					Material:	[AS-LR-NA]
					Cellulose	10
					MMVF	10
2547415-03.1	19-Nov-25	Black/Yellow	Tar/Foam	No	Client ID: S07C	
					Material:	[AS-LR-NA]
					Cellulose	10
					MMVF	10
2547415-03.2	19-Nov-25	Black/Brown	Tar/Cellulose	No	Client ID: S07C	
					Material:	[AS-LR-NA]
					Cellulose	20
					MMVF	10

Total Analyses = 6

Certificate of Analysis

Client: MTE Consultants Inc. (Kitchener)

Client PO: 64457-001

Report Date: 25-Nov-2025

Order Date: 20-Nov-2025

Project Description: 64457-001 - St Aloysius

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	Lab Accreditation	Analysis Date
Asbestos, PLM Visual Estimation	EPA 600/R-93/116	1 - Mississauga	CALA 3762	21-Nov-25

Mississauga Lab: 15 - 6800 Kitimat Rd Mississauga, Ontario, L5N 5M1

Qualifier Notes

Sample Qualifiers :

AS-LR-NA: Layers/materials inseparable, combined and not analysed separately

Work Order Revisions | Comments

None

Other Report Notes

Samples were analysed as received. Paracel is not responsible for inherent analytical limitations. Analytes in bold indicate asbestos mineral content. All samples where asbestos is detected below 1% include quantity verification with additional analysis steps including gravimetric reduction and/or point counting. Problem matrices, such as those high in cellulose and/or non-friable organically bound materials, routinely include additional gravimetric reduction to remove interfering fibers/binders. Content denoted as '<MDL' indicates trace asbestos was observed below the noted detection limit, but could not be accurately quantified. Content denoted as 'Present' indicates that only a qualitative analysis was possible as a consequence of the sample matrix. Sample collection according to the regulation/method recommendations is the responsibility of the client.

MMVF: Man Made Vitreous Fibers: Fiberglass, Mineral Wool, Rockwool, Glasswool



2547415



Lab Office
3-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
1-800-749-1947
paracel@paracellabs.com

Chain of Custody
(Lab Use Only)

Page ___ of ___

Client Name: MTE Consultants Inc.	Project Reference: St Aloysius	Turnaround Time: ☐ Immediate ☐ 1 Day -EOD ☐ 4 Hour ☐ 2 Day -EOD ☐ 24 Hour ☐ 3 Day -EOD ☒ Regular
Contact Name: Paul Semeniuk	Quote #: 24-042 MTE Standing Offer	
Address: 520 Bingmans Centre Drive Kitchener ON N2B 3X9	PO #: 64457-001	
Telephone: 519-743-6500	Email Address: psemeniuk@mte85.com jscozzafava@mte85.com	
Date Required:		

ASBESTOS & MOLD ANALYSIS**Matrix:** ☐ Air ☒ Bulk ☐ Tape Lift ☐ Swab ☐ Other **Regulatory Guideline:** ☒ ON ☐ QC ☐ AB ☐ SK ☐ Other:**Analyses:** ☐ Microscopic Mold ☐ Culturable Mold ☐ Bacteria GRAM ☐ PCM Asbestos ☒ PLM Asbestos ☐ Chatfield Asbestos ☐ TEM Asbestos

Paracel Order Number: 2547415		Asbestos - Bulk		Sampling Date	Air Volume (L)	Analysis Required
Sample ID	Materials to Be Analyzed *	POS STOP				
	If Positive Stop requested, indicate if by Sample (SMP) or Material (MAT)	SMP	MAT			
1	S07ABC	Roof sample - built up Tar layer (2), Paper layer with tar (foam/cellulose), Paper layer with tar (drywall/foam)	☐	☒	11/19/2025	PLM
2			☐	☐		
3			☐	☐		
4			☐	☐		
5			☐	☐		
6			☐	☐		
7			☐	☐		
8			☐	☐		
9			☐	☐		
10			☐	☐		

* If left blank, all lab identified distinct materials in each sample will be analyzed and reported separately, as per EPA 600/R-93/116. Additional charges will apply.
Manufactured multi-layered building materials will be analyzed as one sample, unless requested by client.

Comments:	Method of Delivery: Paracel

Submitting adequate sample volume is the responsibility of the client. Refer to the reverse of this CoC for recommended sample volumes. Signing this CoC authorizes Paracel to complete the analysis on the sample as submitted.

Relinquished By (Sign): Jason Scozzafava	Received at Depot:	Received at Lab: JH	Verified By: JH
Date/Time: November 19, 2025,	Date/Time:	Date/Time: Nov 20/25	Date/Time: Nov 20/25

13.00

14.24

Certificate of Analysis

MTE Consultants Inc. (Kitchener)

520 Bingham Centre Dr.

Kitchener, ON N2B 3X9

Attn: Paul Semeniuk

Client PO: 64457-001

Project: 64457-001 - St. Aloysius

Custody:

Report Date: 19-Nov-2025

Order Date: 14-Nov-2025

Order #: 2546469

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

Paracel ID	Client ID
2546469-01	LP1
2546469-02	LP2

Approved By:



Alex Enfield, MSc
Lab Manager

Any use of these results implies your agreement that our total liability in connection with this work, however arising shall be limited to the amount paid by you for this work, and that our employees or agents shall not under circumstances be liable to you in connection with this work

Certificate of Analysis

Report Date: 19-Nov-2025

Client: MTE Consultants Inc. (Kitchener)

Order Date: 14-Nov-2025

Client PO: 64457-001

Project Description: 64457-001 - St. Aloysius

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Metals, ICP-MS	EPA 6020 - Digestion - ICP-MS	17-Nov-25	17-Nov-25

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions/Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

Certificate of Analysis

Report Date: 19-Nov-2025

Client: MTE Consultants Inc. (Kitchener)

Order Date: 14-Nov-2025

Client PO: 64457-001

Project Description: 64457-001 - St. Aloysius

Sample Results

Lead					Matrix: Paint
Parcel ID	Client ID	Sample Date	Units	MDL	Result
2546469-01	LP1	12-Nov-25	ug/g	5	2910
2546469-02	LP2	12-Nov-25	ug/g	5	856

Laboratory Internal QA/QC

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Matrix Blank									
Lead	ND	5	ug/g						
Matrix Duplicate									
Lead	320	5	ug/g	332			3.85	50	
Matrix Spike									
Lead	57.4	5.00	ug/g	13.3	88.3	70-130			



Parcel ID: 2546469



PARACEL LABO					
Sample ID	Location	Colour		Date	Notes
LP1	Classroom 1000	White/Beige	Wall	11/12/2025	
LP2	Corridor 1008	White/Light Blue	Wall	11/12/2025	

Certificate of Analysis

MTE Consultants Inc. (Kitchener)

520 Bingham Centre Dr.

Kitchener, ON N2B 3X9

Attn: Paul Semeniuk

Client PO: 64457 -001

Project: 64457 -001 - St. Aloysius

Custody:

Report Date: 25-Nov-2025

Order Date: 19-Nov-2025

Order #: 2547239

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

Paracel ID	Client ID
2547239-01	LP3

Approved By:



Milan Ralitsch, PhD
Senior Technical Manager

Any use of these results implies your agreement that our total liability in connection with this work, however arising shall be limited to the amount paid by you for this work, and that our employees or agents shall not under circumstances be liable to you in connection with this work

Certificate of Analysis

Report Date: 25-Nov-2025

Client: MTE Consultants Inc. (Kitchener)

Order Date: 19-Nov-2025

Client PO: 64457 -001

Project Description: 64457 -001 - St. Aloysius

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Metals, ICP-MS	EPA 6020 - Digestion - ICP-MS	20-Nov-25	20-Nov-25

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions/Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

Certificate of Analysis

Report Date: 25-Nov-2025

Client: MTE Consultants Inc. (Kitchener)

Order Date: 19-Nov-2025

Client PO: 64457 -001

Project Description: 64457 -001 - St. Aloysius

Sample Results

Lead					Matrix: Paint
Parcel ID	Client ID	Sample Date	Units	MDL	Result
2547239-01	LP3	18-Nov-25	ug/g	5	13

Laboratory Internal QA/QC

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Matrix Blank									
Lead	ND	5	ug/g						
Matrix Duplicate									
Lead	ND	5	ug/g	ND			NC	50	
Matrix Spike									
Lead	50.4	5.00	ug/g	ND	101	70-130			

Appendix C

Figures

ASBESTOS-CONTAINING GREY SOFT SEALANT ON EXTERIOR WINDOWS



NOTES:

ALL DRAWINGS TO BE REFERENCED WITH THE ASSOCIATED REPORT, LOCATIONS AND QUANTITIES ARE APPROXIMATE.

ALL KNOWN OR SUSPECT ASBESTOS-CONTAINING MATERIALS ARE NOT DEPICTED ON THIS DRAWING. REFER TO THE REPORT FOR A COMPLETE LIST OF IDENTIFIED MATERIALS.

THIS FIGURE IS COLOUR DEPENDENT. PHOTOCOPIES MAY ALTER INTERPRETATION OF THE FIGURE. ALWAYS REFER TO ORIGINAL DRAWINGS AND REPORT.

- Legend**
- 13 Location Number
 - Renovation Scope of Work
 - Post 1990 Construction

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

MTE

Ph. (519) 743-6500 www.mte85.com

CLIENT

WATERLOO CATHOLIC DISTRICT SCHOOL BOARD

PROJECT

2025 LIMITED DESIGNATED SUBSTANCE AUDIT

DRAWING

ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL (Kitchener)

FIRST LEVEL

Project Manager	PXS	Date	DECEMBER 2025
Design By	WCDSB	Project No.	64457_001
Drawn By	PXS	Drawing No.	1.0
Scale	N.T.S.		



CHUNG & VANDER DOELEN
ENGINEERING LTD.

**GEOTECHNICAL INVESTIGATION
PROPOSED BUILDING ADDITION**

504 Connaught Street
Kitchener, Ontario

SUBMITTED TO:

Waterloo Catholic District School Board
480 Dutton Drive
Waterloo, Ontario
N2L 4C6

ATTENTION:

Mr. Simon Marshall



CHUNG & VANDER DOELEN
ENGINEERING LTD.

311 VICTORIA STREET NORTH
KITCHENER / ONTARIO / N2H 5E1
519-742-8979

May 26, 2025
File No.: 2464

Waterloo Catholic District School Board
480 Dutton Drive
Waterloo, Ontario
N2L 4C6

Attention: Mr. Simon Marshall

RE: Geotechnical Investigation
Proposed Building Addition
504 Connaught Street, Kitchener, Ontario

We take pleasure in enclosing one (1) copy of our Geotechnical Investigation Report carried out at the above-referenced Site. Soil samples will be retained for a period of three (3) months and will thereafter be disposed of unless we are otherwise instructed.

If you have any questions or clarifications are required, please contact the undersigned at your convenience.

We thank you for giving us this opportunity to be of service to you.

Yours truly,
CHUNG & VANDER DOELEN ENGINEERING LTD.

Eric Y. Chung, M.Eng., P.Eng.
Principal Engineer

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LIST OF ENCLOSURES

Appendix A	Limitations of Report
Appendix B	Soil Chemistry Results
Appendix C	Comparison of the Soil Chemistry Results to the Applicable Regulatory Criteria
Enclosure A	Soil Abbreviations and Terms Used on Record of Borehole Log Sheets
Enclosures 1 to 3	Borehole Log Sheets
Enclosure 4	Grain Size Distribution Chart
Drawing No. 1	Borehole Location Plan



1.0 INTRODUCTION

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD) has been retained by Waterloo Catholic District School Board to conduct a geotechnical investigation for a proposed building addition at the St. Aloysius Catholic School located at 504 Connaught Street in Kitchener, Ontario.

It is understood that a 2-storey building addition is proposed on the west side of the existing building along Connaught Street. Basement is not proposed underneath the addition. The finished floor elevation of the proposed addition is expected to match that of the floor of the existing building.

The purpose of the investigation was to determine the subsurface conditions at the site and based on the findings, to make geotechnical recommendations for:

- Site grading and engineered fill construction
- Foundation design recommendations
- Limited State design parameters, bearing capacities, and settlements
- Seismic site classification per OBC 2024
- Slab-on-grade floor recommendations
- Groundwater control during construction
- Backfilling recommendations
- Infiltration rate for storm water management features
- Discussion of analytical soil chemistry results

2.0 FIELD WORK

The field work was conducted on May 9, 2025 and consisted of advancing three (3) boreholes to a depth of 5.00 m below existing grade. The borehole locations are illustrated on the Borehole Location Plan, Drawing No. 1.

The field work was carried out under the supervision of a member of our engineering team, who logged the boreholes in the field, effected the subsurface sampling, and monitored the groundwater conditions. The boreholes were advanced using a track-mounted drilling rig, supplied and operated by a specialist drilling company. The drill rig was equipped with continuous flight hollow stem augers and standard soil sampling equipment.

Standard Penetration Tests (SPTs) in accordance with ASTM Specification D1586, were carried out at frequent intervals of depth, and the results are shown on the Borehole Logs as Penetration Resistance or "N"-values. The compactness condition of the soil strata has been inferred from these test results.

Groundwater conditions were monitored during advancement of the borehole augering and immediately following the withdrawal of drilling augers at each borehole location.

The borehole locations, temporary benchmark, and associated ground surface elevations were surveyed by CVD for the purpose of this report using a Network RTK Global Navigation Satellite System (GNSS)



Receiver. The survey data was collected using The UTM Zone 17N Projection, NAD83(CSR5)v7-2010 datum and Canada Geoid Model HT2_2010v70 (CGVD28).

The ground surface elevations were referenced to a temporary benchmark (TBM) which is shown on Drawing No. 1 and described below:

TBM: Top of manhole in grass area, just north of the existing baseball playground (as shown on Borehole Location Plan)

Elevation: 326.00 m (Geodetic)

3.0 LABORATORY TESTING

3.1 Geotechnical Laboratory Testing

Soil samples obtained from the in-situ tests were examined in the field and subsequently brought to our laboratory for visual and tactile examination to confirm field classification. Moisture content determination of all retrieved samples occurred.

In addition, one (1) grain size distribution analysis was performed on the major soil deposits to confirm field identification and to assist with providing information on soil hydraulic conductivity.

3.2 Environmental Laboratory Testing

Three (3) soil samples were submitted to ALS Laboratories for analysis of Metals and Inorganics, Petroleum Hydrocarbons (PHCs) fractions F1-F4, and Benzene-Toluene-Ethylbenzene-Xylene (BTEX). The chemical testing was conducted to initially assess the environmental quality of potential excess soil which may be generated and removed off-site during construction activities.

The following table presents the location, depth, description, and parameters analyzed for each soil sample collected and submitted.

Sample I.D.	Sample Depth (mbgs)	Sample Description	Parameters Analysed
BH 1 – SA 1	0.00 to 0.60 m	Granular Fill and Silty Sand to Sand and Silt Fill	Metals and Inorganics, PHCs F1-F4, BTEX
BH 2 – SA 2	0.75 to 1.20 m	Sand and Silt Fill and Native Sand	Metals and Inorganics, PHCs F1-F4, BTEX
BH 3 – SA 1	0.00 to 0.60 m	Topsoil, Granular Fill and Sand and Silt Fill	Metals and Inorganics, PHCs F1-F4, BTEX



The laboratory certificates of chemical analysis and results provided by ALS Laboratories are enclosed in Appendix B. A comparison of the soil chemistry results to the applicable regulatory standard is included in Appendix C. A detailed discussion of the results can be found in Section 7 of this report.

4.0 EXISTING SITE CONDITIONS

The area of the future building addition currently exists as a playground located on the west side of the existing school building.

Site grades generally decline in a northerly direction. The ground surface elevations at the borehole locations ranged between 325.86 and 326.96 m.

5.0 SUBSURFACE CONDITIONS

The detailed subsurface conditions encountered at the boreholes advanced as part of this investigation are shown on the Borehole Log Sheets, Enclosures 1 to 3. The following sections provide descriptions of the major soil deposits encountered at the boreholes. Enclosure A provides explanations of the various soil abbreviations and terms used on these borehole log sheets.

The stratigraphic boundaries shown on the borehole logs are inferred from non-continuous sampling conducted during advancement of the borehole drilling procedures and, therefore, represent transitions between soil types rather than exact planes of geologic change. The subsurface conditions will vary between and beyond the borehole locations.

5.1 Pavement and Topsoil

Pavement structure was encountered at the ground surface at Borehole 2 with measured asphalt and granular base thicknesses of 100 and 250 mm, respectively.

Topsoil was encountered at the ground surface at Borehole 3 with measured thickness of 25 mm.

5.2 Fill

A thin layer of granular fill materials was encountered at the ground surface at Borehole 1 and below the surficial topsoil at Borehole 3. The granular fill and granular base materials at all three (3) borehole locations were underlain by a layer of fine-grained fill materials which extended to depths between 1.05 and 2.20 m below existing grade.

The fine-grained fill materials consisted of sand and silt with trace gravel. Occasional sand and clayey silt seams/layers were encountered within the fill locally at Borehole 3. Asphalt fragments were encountered within the fill at Boreholes 1 and 2.



The SPT “N”-values measured within the fill materials ranged from weight of hammer to 8 blows per 300 mm penetration, indicating a very loose to loose compactness condition. Natural moisture contents were measured between 8 and 26%, indicating a moist to saturated moisture condition.

5.3 Fine to Medium Sand

The fill materials at all three (3) borehole locations were further underlain by a layer of fine to medium sand deposit with trace to some silt and/or trace gravel. Occasional silt layers were encountered within the granular deposit locally at Borehole 1. The sand deposit at all three (3) borehole locations extended to at least the borehole termination depths of 5.00 m below existing grade.

A grain size distribution analysis was conducted on a representative sample collected from Borehole 3, and the results are shown graphically on Enclosure 4.

The SPT “N”-values measured within the sand deposit ranged from 4 to 32 blows per 300 mm penetration, indicating a loose to dense compactness condition. Natural moisture contents were measured between 2 and 12%, indicating a damp to moist moisture condition.

5.4 Groundwater

Groundwater conditions were monitored during advancement of borehole augering and immediately following withdrawal of the drilling augers at each borehole location.

Upon withdrawal of the drilling augers, all three (3) boreholes experienced dry cave-in at depths of 4.00 or 4.25 m below existing grade.

Based on the field observations and measured moisture contents, the groundwater table is expected to lie at depths below 5.00 m, the maximum depths of exploration.

It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.



6.0 DISCUSSION AND RECOMMENDATIONS

6.1 General

It is understood that a 2-storey building addition is proposed on the west side of the existing building along Connaught Street. Basement is not proposed underneath the addition. The finished floor elevation of the proposed addition is expected to match that of the floor of the existing building.

In general, the project area is underlain by a layer of very loose to loose fill materials which extended to depths between 1.05 and 2.20 m below existing grade, followed by loose to dense fine to medium sand deposit to at least the borehole termination depths of 5.00 m.

Based on the field observations and measured moisture contents, the groundwater table is expected to lie at depths below 5.00 m, the maximum depths of exploration. It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

6.2 Footing Foundations

Conventional strip and spread footing foundations can be used to support the proposed building addition. Footings cast on the approved engineered fill (as described in Section 6.3) or native compact to dense fine to medium sand deposit can be designed using a Net Geotechnical Reaction at SLS of 150 kPa. The SLS value given above is based on a maximum settlement of 25 mm under the footing foundations. The Factored Net Geotechnical Bearing Resistance at ULS is 250 kPa.

The following table summarizes the highest founding level and elevation for conventional footing foundations on the upper competent native soils encountered at the borehole locations:

Borehole No.	Existing Ground Elevation (m)	Highest Founding Depth (m)	Highest Founding Elevation (m)
1	325.92	1.82	324.10
2	325.96	1.46	324.50
3	326.86	2.26	324.60

These bearing pressures can be achieved provided that the founding subgrade is undisturbed during construction.

Addition footings should be founded below any existing fill and loose native soil, previous building foundations, and utility trenches on competent native undisturbed soil deposits. Spacing between adjacent footing steps should not be steeper than 10H to 7V.

The maximum total and differential settlements of footings designed to the above recommended soil bearing pressures are expected to be less than 25 and 20 mm, respectively, and these are considered



tolerable for the structure being contemplated.

Exterior footings and footings in unheated portions of the building should be provided with a soil cover of not less than 1.2 m or equivalent thermal insulation for adequate frost protection. The founding subgrade soils must be protected from frost penetration during winter construction.

It is recommended that the footing excavations be inspected by the geotechnical engineer to ensure adequate soil bearing and proper subgrade preparation.

6.3 Engineered Fill Construction

The existing topsoil, pavement structure, fill materials and loose native sand deposit are not considered suitable for supporting the building foundations and floor slabs of the proposed addition in their present condition. It is recommended to remove these poor condition soils and construct engineered fill to suitably support the future building foundations and floor slabs.

Imported well-graded sand and gravel meeting the gradational requirements of OPSS Granular B Type I is to be used to construct engineered fill under controlled and supervised conditions. The moisture content of the soil should be within 2% dry of its optimum moisture condition.

Engineered fill is to be constructed in accordance with the following procedures in order to support the future foundations and floor slabs, if adopted:

1. All existing topsoil, pavement materials, fill, loose native sand deposit and otherwise deleterious materials are to be excavated/removed to expose the underlying competent native subgrade;
2. The exposed subgrade surface is to be thoroughly recompact by large heavy compaction equipment (10 tonne recommended) and inspected by qualified geotechnical personnel. Any loose or soft areas identified should be excavated to the level of competent soil;
3. The required grades can then be achieved by placing imported sand and gravel (OPSS Granular B Type I) in maximum 300 mm thick lifts and compacted to no less than 100% Standard Proctor maximum dry density (SPMDD) to the underside of the proposed footings and to at least 95% SPMDD for floor slab support. The moisture content of the soil requires to be within 3% dry of its optimum moisture condition to achieve the specified degree of compaction.
4. Engineered fill must be placed such that the fill pad extends horizontally outwards from all footings/foundation at least the same distance as to how thick the engineered fill pad will exist between the underside of future footings and the approved native subgrade; and
5. All fill placement and compaction operations must be supervised on a full-time basis by qualified geotechnical personnel to approve fill material and ensure the specified degree of compaction has been achieved.



Footings cast on approved engineered fill can be designed using a Net Geotechnical Reaction of 150 kPa at SLS and a Factored Geotechnical Resistance of 250 kPa at ULS.

Vibration could be generated from various construction equipment, such as compactors and rollers which could be harmful to potential surrounding structures and buildings during construction. Peak particle velocity (PPV) of ground motion is widely accepted as the best descriptor of potential for vibration damage to structures. The safe vibration limit can be set to 8 to 25 mm/s PPV, depending on the sensitivity of any potential surrounding structures to vibration.

Vibration monitoring can be carried out to measure the PPV of ground motion from vibration generated from typical compaction equipment at the beginning of the project in the potentially critical areas. This will set criteria and establish the type of equipment to be used for this project. A pre-construction condition survey could be conducted to document the condition of the existing structures within the possible zone of influence, if necessary.

6.4 Earthquake Considerations

In accordance with The Ontario Building Code 2024 (OBC), the proposed structure should be designed to resist earthquake load and effects as per OBC Subsection 4.1.8.

Based on the underlying soil conditions encountered at the boreholes and a review of nearby publicly available deeper boreholes, the site can be classified as a Site Class D as per OBC Table 4.1.8.4.B.

6.5 Floor Slab Construction

The floor slabs can be constructed as conventional slab-on-grade on approved engineered fill or competent native sand deposit. The exposed subgrade should be inspected by the geotechnical engineer at the time of floor slab construction. Any soft and/or unstable areas should be replaced with granular fill which should be compacted to at least 95% SPMDD.

It is recommended that a minimum 150 mm thick layer of OPSS Granular "A" be placed and compacted to at least 100% SPMDD beneath the concrete floor slab to provide uniform support.

A modulus of subgrade reaction (k_s) of 40 MN/m³ may be used for the design of the floor slab, assuming a well-compacted stable sand subgrade. Where the floor subgrade consists of engineered fill (well-compacted Granular "B" at least 0.6 m thick), the modulus of subgrade reaction can be taken as 80 MN/m³.

The floor slab should be separated structurally from the columns and foundation walls. Sawcut control joints should be provided at regular spacing (less than 30 times the concrete slab thickness) and to depths between one-third to one-quarter of the slab thickness.

Care should be taken to ensure that the backfill against foundation walls and interior piers/columns are placed in thin layers and each layer compacted to at least 95% SPMDD. These types of confined areas



should be backfilled with imported granular soils such as OPSS Granular B Type I.

6.6 Open Cut Excavation and Groundwater Control

Excavations are expected to be up to $2.5\pm$ m deep for engineered fill and foundation construction. The excavations are expected to generally penetrate the surficial pavement structure and very loose to loose fill materials. These materials are generally considered to be Type 3 to Type 4 soils in accordance with the latest Occupational Health and Safety Act.

Excavations in Type 3 Soils (loose fill materials) are expected to remain stable during the construction period provided that the side slopes are cut to 1H : 1V from the bottom of the excavation. Excavation in Type 4 Soils (very loose fill materials) should be cut to 3H : 1V. Alternatively, the side slopes should be supported by a prefabricated hydraulic or engineered support system (both are to be designed by a professional engineer and should be constructed, installed, used, and maintained in accordance with the design drawings and specifications).

The side slopes should be suitably protected from erosion processes. Should unstable and/or wet conditions be encountered, side slopes are to be flattened to a stable configuration.

Uncontrollable groundwater flows are not expected to be encountered within the anticipated construction excavations. Subsurface seepage and surface water runoff into the excavations may be controlled by conventional sump pumping techniques, as and where required.

6.7 Lateral Earth Pressure

The unbalanced foundation walls and any other soil retaining structures should be designed to resist the lateral earth pressure acting against these walls. The following formula may be used to calculate the unfactored earth pressure distribution. The factored resistance can be calculated by using a factor of 0.8.

$$P = K (\gamma H + q)$$

where:

P =	Lateral earth pressure	kPa
K =	earth pressure coefficient, 0.5 for non-yielding foundation wall earth pressure coefficient, 0.3 for yielding retaining wall	
γ =	unit weight of granular backfill, compacted to 95% SPMDD	21 kN/m ³
H =	unbalanced height of wall	m
q =	surcharge load at ground surface	kPa

The backfill for the foundation walls and retaining walls should be free-draining granular materials which



should have less than 8% silt particles (OPSS Granular “B” Type I). The backfill should be placed in thin layers and compacted to 95% SPMD. Over-compaction adjacent to the foundation/retaining walls should be avoided. Compaction should be carried out with hand operated equipment within 1 m of the foundation wall or retaining wall. Weeping tiles leading to a frost-free outlet or weep holes should be installed to effect drainage behind the retaining wall.

The sliding resistance of the retaining wall footings should be checked. The unfactored horizontal resistance against sliding between cast-in-place concrete and the various soils can be calculated using the following unit weight and friction coefficient:

Soil	Unit Weight (kN/m ³)	Friction Coefficient
Well Compacted Engineered Fill	21	0.45
Compact to Dense Fine to Medium Sand	20	0.40

6.8 Hydraulic Conductivity and Infiltration Rates

Based on the results of grain size analyses and our experience, the hydraulic conductivity and infiltration rate of the native inorganic soil types encountered at the boreholes are estimated and provided in the following table and may be used for storm water management purposes:

Material	Hydraulic Conductivity (K) (cm/sec)	Infiltration Rate (mm/hr)
Fine to Medium Sand (Enclosure 4)	1×10^{-2} to 3×10^{-2}	100 to 150

7.0 GEO-ENVIRONMENTAL CONSIDERATIONS

Excess soil may be generated and removed off-site during the construction activities associated with the proposed site works. The management of excess soil is now governed by Ontario Regulation 406/19 (O. Reg. 406/19), MECP document titled “On-Site and Excess Soil Management Regulation”. In accordance with the regulation, the Project Leader is responsible for the handling, storage, reuse, transportation, and removal of all soil. Furthermore, the analytical results must be disclosed with and approved by the owner(s) of the receiving site before exporting the soil.

Considering the sites industrial property use, the following is required for on-site and excess soil management:

- Planning Documentation
 - Assessment of Past Use
 - Sampling and Analysis Plan



- Excess Soil Characterization Report
 - Excess Soil Destination Report
- Tracking
- Registry
- Record Keeping

An initial testing program was conducted during the geotechnical investigation and the analytical results are discussed in the following sections of this report. Additional soil sampling and analysis may be required as per the above-noted MECP document and/or as per the requirement of the receiving site owner(s), depending on the volume of excess soil generated during construction.

Any soils identified during construction to have been environmentally impacted are to be separately stockpiled and analysed to determine the appropriate measures for handling and disposal. Waste characterization testing (TCLP) to classify the material for disposal as prescribed in O.Reg. 347/558 is required. Leachate analysis (mSPLP) is to be carried out if the excess soil is to be disposed to receiving sites under O.Reg. 406/19.

Similarly, groundwater encountered during construction works must also be suitably assessed and handled.

7.1 Applicable Regulatory Standards

The Soil, Ground Water and Sediment Standards for Use Under the New Soil Rules and Excess Soil Quality Standards established in accordance with the O.Reg. 406/19 as amended were consulted in the assessment of the soil at the project site.

The analytical results for soils were compared to the following O. Reg. 406/19 regulatory standards:

- Table 1 (Full Depth Background Site Condition Standards) for Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use (Table 1 RPIICC ESQS)
- Table 2.1 (Full Depth Generic Excess Soil Quality Standards in a Potable Ground Water Condition) for Residential/Parkland/Institutional Property Use (Table 2.1 RPI ESQS)
- Table 2.1 (Full Depth Excess Soil Quality Standards in a Potable Ground Water Condition) for Industrial/Commercial/Community Property Use (Table 2.1 ICC ESQS)

7.2 Handling of Excess Soil

In support of on-site and excess soil management, an initial chemical testing program was conducted as part of this geotechnical investigation. Three (3) soil samples were collected and submitted to AGAT Laboratories for analysis of Metals and Inorganics, Petroleum Hydrocarbons (PHCs) fractions F1-F4, and Benzene-Toluene-Ethylbenzene-Xylene (BTEX).



The table below outlines a summary of the samples submitted for chemical analysis and all exceedances:

Sample	Table 1	Table 2.1 RPI	Table 2.1 ICC	Exceedance Parameter(s)
BH 1 – SA 1	✓	✓	✓	-
BH 2 – SA 2	×	×	✓	SAR, F4 and F4G-SG
BH 3 – SA 1	✓	✓	✓	-

The analytical results for metals & inorganics (including SAR and Electrical Conductivity) indicate that the tested soil samples from BH 2 – SA 2 exceed the allowable concentration limits under Table 1 and Table 2.1 RPI standards.

The analytical results for BTEX indicate that the tested soils meet the allowable concentration limits under Table 1 and Table 2.1 standards.

The analytical results for PHCs indicate that the tested soil samples from BH2 – SA2 exceed the allowable concentration limits under Table 1 standards, which is due to the presence of asphalt fragments.

If excess soils are anticipated to be generated, further analytical testing is recommended to be completed prior to or during the construction phase. It is also recommended that TCLP testing should also be completed at that time. CVD can provide excess soil management recommendations for impacted areas after delineation and additional testing is completed.

Any soils identified during construction to have been environmentally impacted are to be separately stockpiled and analysed to determine appropriate measures for handling and disposal. Waste characterization testing (TCLP) to classify the material for disposal as prescribed in Ontario Regulation 347/558 is required. Leachate analysis (mSPLP) is to be carried out if the excess soil is to be disposed to receiving sites under O.Reg. 406/19.

CVD further recommends that a disposal plan for excess soils be established to manage the quantity, as well as where and how the excess soils can be disposed of off-site.



8.0 CLOSURE

The Limitations of Report, as quoted in Appendix A, is an integral part of this report.

We trust that the information presented in this report is complete within our terms of reference. If there are any further questions concerning this report, please do not hesitate to contact our office.

Yours truly,

CHUNG & VANDER DOELEN ENGINEERING LTD.

Nandou Zhao., M.Eng., P.Eng.
Manager – Geotechnical Services



Eric Y. Chung, M.Eng., P.Eng.
Principal Engineer



APPENDIX A

LIMITATIONS OF REPORT



APPENDIX “A”

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes and their respective depths may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. CHUNG & VANDER DOELEN ENGINEERING LIMITED accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report.



APPENDIX B

SOIL CHEMISTRY RESULTS





CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: WT2511456		
Client	: Chung and Vander Doelen Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Joel Rudd	Account Manager	: Andrew Martin
Address	: 311 Victoria St. N. Kitchener Ontario Canada N2H 5E1	Address	: 60 Northland Road, Unit 1 Waterloo ON Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 2464	Date Samples Received	: 14-May-2025 13:00
PO	: ----	Date Analysis Commenced	: 14-May-2025
C-O-C number	: 20-948856	Issue Date	: 22-May-2025 16:59
Sampler	: JR		
Site	: ----		
Quote number	: 2024/2025 Excess Soils Quote		
No. of samples received	: 3		
No. of samples analysed	: 3		

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>
Amaninder Dhillon	Team Lead - Semi-Volatile Instrumentation	Organics, Waterloo, Ontario
Andrea Armstrong	Department Manager - Air Quality and Volatiles	VOC, Waterloo, Ontario
Jocelyn Kennedy	Department Manager - Semi-Volatile Organics	Organics, Waterloo, Ontario
Nik Perkio	Senior Analyst	Inorganics, Waterloo, Ontario
Nik Perkio	Senior Analyst	Metals, Waterloo, Ontario
Niral Patel		Centralized Prep, Waterloo, Ontario
Walt Kippenhuck	Supervisor - Inorganic	Inorganics, Waterloo, Ontario
Walt Kippenhuck	Supervisor - Inorganic	Metals, Waterloo, Ontario



Summary of Guideline Breaches by Sample

SampleID/Client ID	Matrix	Analyte	Analyte Summary	Guideline	Category	Result	Limit
BH2-SA2	Soil/Solid	Sodium adsorption ratio [SAR]		ON153/04	T1-RPIICC	8.62 -	2.4 -
	Soil/Solid	F4 (C34-C50)		ON153/04	T1-RPIICC	240 mg/kg	120 µg/g
	Soil/Solid	F4G-sg		ON153/04	T1-RPIICC	760 mg/kg	120 µg/g
	Soil/Solid	Sodium adsorption ratio [SAR]		ON406	T2.1-S-RPI	8.62 -	5 -



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.

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: LOR: Limit of Reporting (detection limit).

Unit	Description
-	no units
%	percent
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mS/cm	millisiemens per centimetre
pH units	pH units

>: 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.



Analytical Results Evaluation

Matrix: Soil/Solid				<i>Client sample ID</i>	BH1-SA1	BH2-SA2	BH3-SA1	----	----	----	----
<i>Client sampling date / time</i>					09-May-2025 12:00	09-May-2025 12:00	09-May-2025 12:00	----	----	----	----
<i>Sub-Matrix</i>					Soil	Soil	Soil	----	----	----	----
<i>Analyte</i>	<i>CAS Number</i>	<i>Method/Lab</i>	<i>Unit</i>		WT2511456-001	WT2511456-002	WT2511456-003	----	----	----	----
					Result	Result	Result	----	----	----	----
Physical Tests											
Conductivity (1:2 leachate)	----	E100-L/WT	mS/cm		0.0994	0.461	0.0879	----	----	----	----
Moisture	----	E144/WT	%		8.16	4.82	11.7	----	----	----	----
pH (1:2 soil:CaCl2-aq)	----	E108A/WT	pH units		7.50	9.90	7.26	----	----	----	----
Cyanides											
Cyanide, weak acid dissociable	----	E336A/WT	mg/kg		<0.050	<0.050	<0.050	----	----	----	----
Fixed-Ratio Extractables											
Calcium, soluble ion content	7440-70-2	E484/WT	mg/L		3.67	4.14	0.98	----	----	----	----
Magnesium, soluble ion content	7439-95-4	E484/WT	mg/L		1.81	<0.50	0.97	----	----	----	----
Sodium, soluble ion content	17341-25-2	E484/WT	mg/L		0.58	63.7	5.00	----	----	----	----
Sodium adsorption ratio [SAR]	----	E484/WT	-		<0.10	8.62	0.86	----	----	----	----
Metals											
Antimony	7440-36-0	E440C/WT	mg/kg		<0.10	<0.10	<0.10	----	----	----	----
Arsenic	7440-38-2	E440C/WT	mg/kg		2.24	1.25	1.21	----	----	----	----
Barium	7440-39-3	E440C/WT	mg/kg		19.8	9.27	14.2	----	----	----	----
Beryllium	7440-41-7	E440C/WT	mg/kg		0.24	0.10	0.18	----	----	----	----
Boron	7440-42-8	E440C/WT	mg/kg		<5.0	<5.0	<5.0	----	----	----	----
Boron, hot water soluble	7440-42-8	E487/WT	mg/kg		<0.10	0.35	<0.10	----	----	----	----
Cadmium	7440-43-9	E440C/WT	mg/kg		0.143	0.127	0.096	----	----	----	----
Chromium	7440-47-3	E440C/WT	mg/kg		8.64	5.97	6.22	----	----	----	----



Matrix: Soil/Solid

Matrix: Soil/Solid				Client sample ID	BH1-SA1	BH2-SA2	BH3-SA1	----	----	----	----
				Client sampling date / time	09-May-2025 12:00	09-May-2025 12:00	09-May-2025 12:00	----	----	----	----
				Sub-Matrix	Soil	Soil	Soil	----	----	----	----
Analyte	CAS Number	Method/Lab	Unit	WT2511456-001	WT2511456-002	WT2511456-003	----	----	----	----	
											Result
Metals											
Cobalt	7440-48-4	E440C/WT	mg/kg	2.57	1.59	2.11	----	----	----	----	
Copper	7440-50-8	E440C/WT	mg/kg	5.28	4.16	2.64	----	----	----	----	
Lead	7439-92-1	E440C/WT	mg/kg	6.00	6.88	4.63	----	----	----	----	
Mercury	7439-97-6	E510C/WT	mg/kg	<0.200	<0.0050	0.0090	----	----	----	----	
Molybdenum	7439-98-7	E440C/WT	mg/kg	0.15	0.19	0.11	----	----	----	----	
Nickel	7440-02-0	E440C/WT	mg/kg	5.77	3.13	3.98	----	----	----	----	
Selenium	7782-49-2	E440C/WT	mg/kg	<0.20	<0.20	<0.20	----	----	----	----	
Silver	7440-22-4	E440C/WT	mg/kg	<0.10	<0.10	<0.10	----	----	----	----	
Thallium	7440-28-0	E440C/WT	mg/kg	<0.050	<0.050	<0.050	----	----	----	----	
Uranium	7440-61-1	E440C/WT	mg/kg	0.379	0.299	0.230	----	----	----	----	
Vanadium	7440-62-2	E440C/WT	mg/kg	16.9	15.7	13.4	----	----	----	----	
Zinc	7440-66-6	E440C/WT	mg/kg	31.4	41.8	24.6	----	----	----	----	
Speciated Metals											
Chromium, hexavalent [Cr VI]	18540-29-9	E532/WT	mg/kg	0.18	<0.10	0.19	----	----	----	----	
Volatile Organic Compounds											
Benzene	71-43-2	E611A/WT	mg/kg	<0.0050	<0.0050	<0.0050	----	----	----	----	
Ethylbenzene	100-41-4	E611A/WT	mg/kg	<0.015	<0.015	<0.015	----	----	----	----	
Toluene	108-88-3	E611A/WT	mg/kg	<0.050	<0.050	<0.050	----	----	----	----	
Xylene, m+p-	179601-23-1	E611A/WT	mg/kg	<0.030	<0.030	<0.030	----	----	----	----	
Xylene, o-	95-47-6	E611A/WT	mg/kg	<0.030	<0.030	<0.030	----	----	----	----	



Matrix: Soil/Solid

Matrix: Soil/Solid				Client sample ID	BH1-SA1	BH2-SA2	BH3-SA1	----	----	----	----
				Client sampling date / time	09-May-2025 12:00	09-May-2025 12:00	09-May-2025 12:00	----	----	----	----
				Sub-Matrix	Soil	Soil	Soil	----	----	----	----
Analyte	CAS Number	Method/Lab	Unit	WT2511456-001	WT2511456-002	WT2511456-003	----	----	----	----	----
			Result								
Volatile Organic Compounds											
Xylenes, total	1330-20-7	E611A/WT	mg/kg	<0.050	<0.050	<0.050	----	----	----	----	----
BTEX, total	----	E611A/WT	mg/kg	<0.10	<0.10	<0.10	----	----	----	----	----
Hydrocarbons											
F1 (C6-C10)	----	E581.F1/WT	mg/kg	<5.0	<5.0	<5.0	----	----	----	----	----
F2 (C10-C16)	----	E601.SG-L/WT	mg/kg	<10	<10	<10	----	----	----	----	----
F3 (C16-C34)	----	E601.SG-L/WT	mg/kg	<50	113	<50	----	----	----	----	----
F4 (C34-C50)	----	E601.SG-L/WT	mg/kg	<50	240	<50	----	----	----	----	----
F4G-sg	----	E601.F4G-L/WT	mg/kg	----	760	----	----	----	----	----	----
F1-BTEX	----	EC580/WT	mg/kg	<5.0	<5.0	<5.0	----	----	----	----	----
Hydrocarbons, total (C6-C50)	n/a	EC581/WT	mg/kg	<80	353	<80	----	----	----	----	----
Chromatogram to baseline at nC50	n/a	E601.SG-L/WT	-	YES	NO	YES	----	----	----	----	----
Hydrocarbons Surrogates											
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	392-83-6	E601.SG-L/WT	%	86.1	79.8	82.4	----	----	----	----	----
Dichlorotoluene, 3,4-	95-75-0	E581.F1/WT	%	86.9	81.1	76.5	----	----	----	----	----
Volatile Organic Compounds Surrogates											
Bromofluorobenzene, 4-	460-00-4	E611A/WT	%	85.3	92.0	86.8	----	----	----	----	----
Difluorobenzene, 1,4-	540-36-3	E611A/WT	%	87.9	91.2	84.5	----	----	----	----	----

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



Summary of Guideline Limits

Analyte	CAS Number	Unit	ON153/04 T1-RPIICC	ON406 T2.1-S-ICC	ON406 T2.1-S-RPI				
Physical Tests									
Conductivity (1:2 leachate)		mS/cm	0.57 mS/cm	1.4 mS/cm	0.7 mS/cm	----	----	----	----
Moisture	----	%	----	----	----	----	----	----	----
pH (1:2 soil:CaCl2-aq)		pH units	----	----	----	----	----	----	----
Cyanides									
Cyanide, weak acid dissociable		mg/kg	0.051 µg/g	0.051 µg/g	0.051 µg/g	----	----	----	----
Fixed-Ratio Extractables									
Calcium, soluble ion content	7440-70-2	mg/L	----	----	----	----	----	----	----
Magnesium, soluble ion content	7439-95-4	mg/L	----	----	----	----	----	----	----
Sodium, soluble ion content	17341-25-2	mg/L	----	----	----	----	----	----	----
Sodium adsorption ratio [SAR]		-	2.4 -	12 -	5 -	----	----	----	----
Metals									
Antimony	7440-36-0	mg/kg	1.3 µg/g	40 µg/g	7.5 µg/g	----	----	----	----
Arsenic	7440-38-2	mg/kg	18 µg/g	18 µg/g	18 µg/g	----	----	----	----
Barium	7440-39-3	mg/kg	220 µg/g	670 µg/g	390 µg/g	----	----	----	----
Beryllium	7440-41-7	mg/kg	2.5 µg/g	8 µg/g	4 µg/g	----	----	----	----
Boron	7440-42-8	mg/kg	36 µg/g	120 µg/g	120 µg/g	----	----	----	----
Boron, hot water soluble	7440-42-8	mg/kg	----	2 µg/g	1.5 µg/g	----	----	----	----
Cadmium	7440-43-9	mg/kg	1.2 µg/g	1.9 µg/g	1.2 µg/g	----	----	----	----
Chromium	7440-47-3	mg/kg	70 µg/g	160 µg/g	160 µg/g	----	----	----	----
Cobalt	7440-48-4	mg/kg	21 µg/g	80 µg/g	22 µg/g	----	----	----	----
Copper	7440-50-8	mg/kg	92 µg/g	230 µg/g	140 µg/g	----	----	----	----
Lead	7439-92-1	mg/kg	120 µg/g	120 µg/g	120 µg/g	----	----	----	----
Mercury	7439-97-6	mg/kg	0.27 µg/g	0.27 µg/g	0.27 µg/g	----	----	----	----



Molybdenum	7439-98-7	mg/kg	2 µg/g	40 µg/g	6.9 µg/g	----	----	----	----
Nickel	7440-02-0	mg/kg	82 µg/g	270 µg/g	100 µg/g	----	----	----	----
Selenium	7782-49-2	mg/kg	1.5 µg/g	5.5 µg/g	2.4 µg/g	----	----	----	----
Silver	7440-22-4	mg/kg	0.5 µg/g	40 µg/g	20 µg/g	----	----	----	----
Thallium	7440-28-0	mg/kg	1 µg/g	3.3 µg/g	1 µg/g	----	----	----	----
Uranium	7440-61-1	mg/kg	2.5 µg/g	33 µg/g	23 µg/g	----	----	----	----
Vanadium	7440-62-2	mg/kg	86 µg/g	86 µg/g	86 µg/g	----	----	----	----
Zinc	7440-66-6	mg/kg	290 µg/g	340 µg/g	340 µg/g	----	----	----	----
Speciated Metals									
Chromium, hexavalent [Cr VI]	18540-29-9	mg/kg	0.66 µg/g	8 µg/g	8 µg/g	----	----	----	----
Volatile Organic Compounds									
Benzene	71-43-2	mg/kg	0.02 µg/g	0.02 µg/g	0.02 µg/g	----	----	----	----
Ethylbenzene	100-41-4	mg/kg	0.05 µg/g	0.05 µg/g	0.05 µg/g	----	----	----	----
Toluene	108-88-3	mg/kg	0.2 µg/g	0.2 µg/g	0.2 µg/g	----	----	----	----
Xylene, m+p-	179601-23-1	mg/kg	----	----	----	----	----	----	----
Xylene, o-	95-47-6	mg/kg	----	----	----	----	----	----	----
Xylenes, total	1330-20-7	mg/kg	0.05 µg/g	0.091 µg/g	0.091 µg/g	----	----	----	----
BTEX, total		mg/kg	----	----	----	----	----	----	----
Hydrocarbons									
F1 (C6-C10)		mg/kg	25 µg/g	25 µg/g	25 µg/g	----	----	----	----
F2 (C10-C16)	----	mg/kg	10 µg/g	26 µg/g	10 µg/g	----	----	----	----
F3 (C16-C34)	----	mg/kg	240 µg/g	240 µg/g	240 µg/g	----	----	----	----
F4 (C34-C50)	----	mg/kg	120 µg/g	3300 µg/g	2800 µg/g	----	----	----	----
F4G-sg		mg/kg	120 µg/g	3300 µg/g	2800 µg/g	----	----	----	----
F1-BTEX		mg/kg	25 µg/g	25 µg/g	25 µg/g	----	----	----	----
Hydrocarbons, total (C6-C50)	n/a	mg/kg	----	----	----	----	----	----	----
Chromatogram to baseline at nC50	n/a	-	----	----	----	----	----	----	----
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	392-83-6	%	----	----	----	----	----	----	----



Bromofluorobenzene, 4-	460-00-4	%	----	----	----	----	----	----	----
Dichlorotoluene, 3,4-	95-75-0	%	----	----	----	----	----	----	----
Difluorobenzene, 1,4-	540-36-3	%	----	----	----	----	----	----	----

Key:

ON153/04		Ontario Regulation 153/04 - April 15, 2011 Standards (JUL, 2011)
	T1-RPIICC	153 T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
ON406		Ontario Regulation 406/19 - Excess Soils (Bulk)
	T2.1-S-ICC	406 T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use
	T2.1-S-RPI	406 T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: WT2511456	Page	: 1 of 12
Client	: Chung and Vander Doelen Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Joel Rudd	Account Manager	: Andrew Martin
Address	: 311 Victoria St. N. Kitchener ON Canada N2H 5E1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 2464	Date Samples Received	: 14-May-2025 13:00
PO	: ----	Issue Date	: 22-May-2025 16:59
C-O-C number	: 20-948856		
Sampler	: JR		
Site	: ----		
Quote number	: 2024/2025 Excess Soils Quote		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

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

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Holding and Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] BH1-SA1	E336A	09-May-2025	15-May-2025	14 days	6 days	✓	15-May-2025	14 days	0 days	✓
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SA2	E336A	09-May-2025	15-May-2025	14 days	6 days	✓	15-May-2025	14 days	0 days	✓
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] BH3-SA1	E336A	09-May-2025	15-May-2025	14 days	6 days	✓	15-May-2025	14 days	0 days	✓
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP] BH1-SA1	E581.F1	09-May-2025	15-May-2025	14 days	6 days	✓	15-May-2025	40 days	0 days	✓
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP] BH2-SA2	E581.F1	09-May-2025	15-May-2025	14 days	6 days	✓	15-May-2025	40 days	0 days	✓
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP] BH3-SA1	E581.F1	09-May-2025	15-May-2025	14 days	6 days	✓	15-May-2025	40 days	0 days	✓
Hydrocarbons : CCME PHCs - F4G by Gravimetry (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SA2	E601.F4G-L	09-May-2025	15-May-2025	14 days	6 days	✓	22-May-2025	40 days	7 days	✓



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH1-SA1	E601.SG-L	09-May-2025	15-May-2025	14 days	6 days	✓	21-May-2025	40 days	6 days	✓
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SA2	E601.SG-L	09-May-2025	15-May-2025	14 days	6 days	✓	21-May-2025	40 days	6 days	✓
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH3-SA1	E601.SG-L	09-May-2025	15-May-2025	14 days	6 days	✓	21-May-2025	40 days	6 days	✓
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP] BH1-SA1	E487	09-May-2025	20-May-2025	180 days	11 days	✓	20-May-2025	180 days	0 days	✓
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SA2	E487	09-May-2025	20-May-2025	180 days	11 days	✓	20-May-2025	180 days	0 days	✓
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP] BH3-SA1	E487	09-May-2025	20-May-2025	180 days	11 days	✓	20-May-2025	180 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH1-SA1	E510C	09-May-2025	20-May-2025	28 days	11 days	✓	20-May-2025	28 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SA2	E510C	09-May-2025	20-May-2025	28 days	11 days	✓	20-May-2025	28 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH3-SA1	E510C	09-May-2025	20-May-2025	28 days	11 days	✓	20-May-2025	28 days	0 days	✓



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method	Method	Sampling Date	Extraction / Preparation				Analysis			
Container / Client Sample ID(s)			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH1-SA1	E440C	09-May-2025	20-May-2025	180 days	11 days	✓	20-May-2025	180 days	11 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SA2	E440C	09-May-2025	20-May-2025	180 days	11 days	✓	20-May-2025	180 days	11 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH3-SA1	E440C	09-May-2025	20-May-2025	180 days	11 days	✓	20-May-2025	180 days	11 days	✓
Metals : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] BH1-SA1	E484	09-May-2025	20-May-2025	180 days	11 days	✓	20-May-2025	180 days	0 days	✓
Metals : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SA2	E484	09-May-2025	20-May-2025	180 days	11 days	✓	20-May-2025	180 days	0 days	✓
Metals : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] BH3-SA1	E484	09-May-2025	20-May-2025	180 days	11 days	✓	20-May-2025	180 days	0 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH1-SA1	E100-L	09-May-2025	20-May-2025	30 days	11 days	✓	20-May-2025	30 days	11 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SA2	E100-L	09-May-2025	20-May-2025	30 days	11 days	✓	20-May-2025	30 days	11 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH3-SA1	E100-L	09-May-2025	20-May-2025	30 days	11 days	✓	20-May-2025	30 days	11 days	✓



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method	Method	Sampling Date	Extraction / Preparation				Analysis			
Container / Client Sample ID(s)			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH1-SA1	E144	09-May-2025	----	----	----		15-May-2025	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SA2	E144	09-May-2025	----	----	----		15-May-2025	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH3-SA1	E144	09-May-2025	----	----	----		15-May-2025	----	----	
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] BH1-SA1	E108A	09-May-2025	14-May-2025	30 days	5 days	✓	16-May-2025	30 days	5 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SA2	E108A	09-May-2025	14-May-2025	30 days	5 days	✓	16-May-2025	30 days	5 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] BH3-SA1	E108A	09-May-2025	14-May-2025	30 days	5 days	✓	16-May-2025	30 days	5 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH1-SA1	E532	09-May-2025	15-May-2025	30 days	6 days	✓	16-May-2025	7 days	1 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SA2	E532	09-May-2025	15-May-2025	30 days	6 days	✓	16-May-2025	7 days	1 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH3-SA1	E532	09-May-2025	15-May-2025	30 days	6 days	✓	16-May-2025	7 days	1 days	✓



Matrix: **Soil/Solid**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method	Method	Sampling Date	Extraction / Preparation				Analysis			
Preparation Date			Holding Times		Eval	Analysis Date	Holding Times		Eval	
			Rec	Actual			Rec	Actual		
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP] BH1-SA1	E611A	09-May-2025	15-May-2025	14 days	6 days	✓	15-May-2025	40 days	0 days	✓
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP] BH2-SA2	E611A	09-May-2025	15-May-2025	14 days	6 days	✓	15-May-2025	40 days	0 days	✓
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP] BH3-SA1	E611A	09-May-2025	15-May-2025	14 days	6 days	✓	15-May-2025	40 days	0 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
Analytical Methods			QC	Regular	Actual	Expected	Evaluation
Laboratory Duplicates (DUP)							
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1998529	2	30	6.6	5.0	✔
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1996545	1	14	7.1	5.0	✔
Moisture Content by Gravimetry	E144	1997600	1	11	9.0	5.0	✔
WAD Cyanide (0.01M NaOH Extraction)	E336A	1997598	1	13	7.6	5.0	✔
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1998533	2	18	11.1	5.0	✔
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1998530	2	19	10.5	5.0	✔
Boron-Hot Water Extractable by ICPOES	E487	1998531	2	15	13.3	5.0	✔
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1998532	2	15	13.3	5.0	✔
Hexavalent Chromium (Cr VI) by IC	E532	1997599	1	13	7.6	5.0	✔
CCME PHC - F1 by Headspace GC-FID	E581.F1	1999619	1	20	5.0	5.0	✔
CCME PHCs - F4G by Gravimetry (Low Level)	E601.F4G-L	2009160	0	2	0.0	5.0	✖
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1997597	1	20	5.0	5.0	✔
BTEX by Headspace GC-MS	E611A	1999618	1	20	5.0	5.0	✔
Laboratory Control Samples (LCS)							
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1998529	4	30	13.3	10.0	✔
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1996545	1	14	7.1	5.0	✔
Moisture Content by Gravimetry	E144	1997600	1	11	9.0	5.0	✔
WAD Cyanide (0.01M NaOH Extraction)	E336A	1997598	1	13	7.6	5.0	✔
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1998533	4	18	22.2	10.0	✔
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1998530	4	19	21.0	10.0	✔
Boron-Hot Water Extractable by ICPOES	E487	1998531	4	15	26.6	10.0	✔
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1998532	4	15	26.6	10.0	✔
Hexavalent Chromium (Cr VI) by IC	E532	1997599	2	13	15.3	10.0	✔
CCME PHC - F1 by Headspace GC-FID	E581.F1	1999619	1	20	5.0	5.0	✔
CCME PHCs - F4G by Gravimetry (Low Level)	E601.F4G-L	2009160	1	2	50.0	5.0	✔
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1997597	1	20	5.0	5.0	✔
BTEX by Headspace GC-MS	E611A	1999618	1	20	5.0	5.0	✔
Method Blanks (MB)							
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1998529	2	30	6.6	5.0	✔
Moisture Content by Gravimetry	E144	1997600	1	11	9.0	5.0	✔
WAD Cyanide (0.01M NaOH Extraction)	E336A	1997598	1	13	7.6	5.0	✔
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1998533	2	18	11.1	5.0	✔
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1998530	2	19	10.5	5.0	✔
Boron-Hot Water Extractable by ICPOES	E487	1998531	2	15	13.3	5.0	✔
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1998532	2	15	13.3	5.0	✔



Matrix: **Soil/Solid**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
<i>Analytical Methods</i>	<i>Method</i>	<i>QC Lot #</i>	<i>QC</i>	<i>Regular</i>	<i>Actual</i>	<i>Expected</i>	<i>Evaluation</i>
Method Blanks (MB) - Continued							
Hexavalent Chromium (Cr VI) by IC	E532	1997599	1	13	7.6	5.0	✔
CCME PHC - F1 by Headspace GC-FID	E581.F1	1999619	1	20	5.0	5.0	✔
CCME PHCs - F4G by Gravimetry (Low Level)	E601.F4G-L	2009160	1	2	50.0	5.0	✔
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1997597	1	20	5.0	5.0	✔
BTEX by Headspace GC-MS	E611A	1999618	1	20	5.0	5.0	✔
Matrix Spikes (MS)							
WAD Cyanide (0.01M NaOH Extraction)	E336A	1997598	1	13	7.6	5.0	✔
CCME PHC - F1 by Headspace GC-FID	E581.F1	1999619	1	20	5.0	5.0	✔
CCME PHCs - F4G by Gravimetry (Low Level)	E601.F4G-L	2009160	0	2	0.0	5.0	✖
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1997597	1	20	5.0	5.0	✔
BTEX by Headspace GC-MS	E611A	1999618	1	20	5.0	5.0	✔



Methodology References and Summaries

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. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L ALS Environmental - Waterloo	Soil/Solid	CSSS Ch. 15 (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl ₂ Extraction) - As Received	E108A ALS Environmental - Waterloo	Soil/Solid	MECP E3530	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode. This method is equivalent to ASTM D4972 and is acceptable for topsoil analysis.
Moisture Content by Gravimetry	E144 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
WAD Cyanide (0.01M NaOH Extraction)	E336A ALS Environmental - Waterloo	Soil/Solid	APHA 4500-CN I (mod)	Weak Acid Dissociable (WAD) cyanide is determined after extraction by Continuous Flow Analyzer (CFA) with in-line distillation followed by colourmetric analysis.
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C ALS Environmental - Waterloo	Soil/Solid	EPA 6020B (mod)	This method is intended to liberate metals that may be environmentally available. Samples are dried, then sieved through a 355 µm sieve, and digested with HNO ₃ and HCl. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Silicate minerals are not solubilized. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. This method does not adequately recover elemental sulfur, and is unsuitable for assessment of elemental sulfur standards or guidelines. Analysis is by Collision/Reaction Cell ICPMS.
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484 ALS Environmental - Waterloo	Soil/Solid	SW846 6010C	A dried, disaggregated solid sample is extracted with deionized water, the aqueous extract is separated from the solid, acidified and then analyzed using a ICP/OES. The concentrations of Na, Ca and Mg are reported as per CALA requirements for calculated parameters. These individual parameters are not for comparison to any guideline.



Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Boron-Hot Water Extractable by ICPOES	E487 ALS Environmental - Waterloo	Soil/Solid	HW EXTR, EPA 6010B	A dried solid sample is extracted with calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES. Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C ALS Environmental - Waterloo	Soil/Solid	EPA 200.2/1631 Appendix (mod)	Samples are sieved through a 355 µm sieve, and digested with HNO ₃ and HCl, followed by CVAAS analysis.
Hexavalent Chromium (Cr VI) by IC	E532 ALS Environmental - Waterloo	Soil/Solid	APHA 3500-CR C	Instrumental analysis is performed by ion chromatography with UV detection.
CCME PHC - F1 by Headspace GC-FID	E581.F1 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	CCME Fraction 1 (F1) is analyzed by static headspace GC-FID. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law. Analytical methods for CCME Petroleum Hydrocarbons (PHCs) are validated to comply fully with the Reference Method for the Canada-Wide Standard for PHC. Test results are expressed on a dry weight basis. Unless qualified, all required quality control criteria of the CCME PHC method have been met, including response factor and linearity requirements.
CCME PHCs - F4G by Gravimetry (Low Level)	E601.F4G-L ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	A portion of the silica gel treated sample extract is filtered and dried at 105°C and the mass of the residual gravimetric heavy hydrocarbons (F4G) is determined gravimetrically. Where both F4 and F4G are reported, the greater of both results must be used for comparison to CWS PHC F4 guidelines.
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	Sample extracts are subjected to in-situ silica gel treatment prior to analysis by GC-FID for CCME hydrocarbon fractions (F2-F4). Analytical methods for CCME Petroleum Hydrocarbons (PHCs) are validated to comply fully with the Reference Method for the Canada-Wide Standard for PHC. Test results are expressed on a dry weight basis. Unless qualified, all required quality control criteria of the CCME PHC method have been met, including response factor and linearity requirements.
BTEX by Headspace GC-MS	E611A ALS Environmental - Waterloo	Soil/Solid	EPA 8260D (mod)	Volatile Organic Compounds (VOCs) are analyzed by static headspace GC-MS. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.



Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
F1-BTEX	EC580 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	F1-BTEX is calculated as follows: F1-BTEX = F1 (C6-C10) minus benzene, toluene, ethylbenzene and xylenes (BTEX).
Sum F1 to F4 (C6-C50)	EC581 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	Hydrocarbons, total (C6-C50) is the sum of CCME Fractions F1(C6-C10), F2(C10-C16), F3(C16-C34), and F4(C34-C50). F4G-sg is not used within this calculation due to overlap with other fractions.
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Leach 1:2 Soil:Water for pH/EC	EP108 ALS Environmental - Waterloo	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl ₂ - As Received for pH	EP108A ALS Environmental - Waterloo	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.
Cyanide Extraction for CFA (0.01M NaOH)	EP333A ALS Environmental - Waterloo	Soil/Solid	ON MECP E3015 (mod)	Extraction for various cyanide analysis is by rotary extraction of the soil with 0.01M Sodium Hydroxide.
Digestion for Metals and Mercury (355 µm Sieve)	EP440C ALS Environmental - Waterloo	Soil/Solid	EPA 200.2 (mod)	Samples are sieved through a 355 µm sieve, and digested with HNO ₃ and HCl. This method is intended to liberate metals that may be environmentally available.
Boron-Hot Water Extractable	EP487 ALS Environmental - Waterloo	Soil/Solid	HW EXTR, EPA 6010B	A dried solid sample is extracted with weak calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES. Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011)
Preparation of Hexavalent Chromium (Cr VI) for IC	EP532 ALS Environmental - Waterloo	Soil/Solid	EPA 3060A	Field moist samples are digested with a sodium hydroxide/sodium carbonate solution as described in EPA 3060A.
VOCs Methanol Extraction for Headspace Analysis	EP581 ALS Environmental - Waterloo	Soil/Solid	EPA 5035A (mod)	VOCs in samples are extracted with methanol. Extracts are then prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
PHCs and PAHs Hexane-Acetone Tumbler Extraction	EP601 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1 (mod)	Samples are subsampled and Petroleum Hydrocarbons (PHC) and PAHs are extracted with 1:1 hexane:acetone using a rotary extractor.

QUALITY CONTROL REPORT

Work Order	: WT2511456	Page	: 1 of 14
Client	: Chung and Vander Doelen Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Joel Rudd	Account Manager	: Andrew Martin
Address	: 311 Victoria St. N. Kitchener ON Canada N2H 5E1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 2464	Date Samples Received	: 14-May-2025 13:00
PO	: ----	Date Analysis Commenced	: 14-May-2025
C-O-C number	: 20-948856	Issue Date	: 22-May-2025 16:59
Sampler	: JR		
Site	: ----		
Quote number	: 2024/2025 Excess Soils Quote		
No. of samples received	: 3		
No. of samples analysed	: 3		

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 Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

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.

Signatories	Position	Laboratory Department
Amaninder Dhillon	Team Lead - Semi-Volatile Instrumentation	Waterloo Organics, Waterloo, Ontario
Andrea Armstrong	Department Manager - Air Quality and Volatiles	Waterloo VOC, Waterloo, Ontario
Jocelyn Kennedy	Department Manager - Semi-Volatile Organics	Waterloo Organics, Waterloo, Ontario
Nik Perkio	Senior Analyst	Waterloo Inorganics, Waterloo, Ontario
Nik Perkio	Senior Analyst	Waterloo Metals, Waterloo, Ontario
Niral Patel		Waterloo Centralized Prep, Waterloo, Ontario
Walt Kippenhuck	Supervisor - Inorganic	Waterloo Inorganics, Waterloo, Ontario
Walt Kippenhuck	Supervisor - Inorganic	Waterloo Metals, Waterloo, Ontario



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

= Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.



Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 1996545)											
EO2503650-001	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	7.60	7.63	0.394%	5%	----
Physical Tests (QC Lot: 1997600)											
WT2511483-001	Anonymous	Moisture	----	E144	0.25	%	29.6	29.3	0.982%	20%	----
Physical Tests (QC Lot: 1998529)											
WT2511467-014	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.104 mS/cm	104	0.00%	20%	----
Physical Tests (QC Lot: 1998850)											
WT2511456-002	BH2-SA2	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.461 mS/cm	475	2.99%	20%	----
Cyanides (QC Lot: 1997598)											
WT2511371-001	Anonymous	Cyanide, weak acid dissociable	----	E336A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
Metals (QC Lot: 1998530)											
WT2511467-014	Anonymous	Calcium, soluble ion content	7440-70-2	E484	0.50	mg/L	5.54	5.38	2.93%	30%	----
		Magnesium, soluble ion content	7439-95-4	E484	0.50	mg/L	1.27	1.16	0.11	Diff <2x LOR	----
		Sodium, soluble ion content	17341-25-2	E484	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
Metals (QC Lot: 1998531)											
WT2511423-001	Anonymous	Boron, hot water soluble	7440-42-8	E487	0.10	mg/kg	0.75	0.74	0.985%	40%	----
Metals (QC Lot: 1998532)											
WT2511423-001	Anonymous	Mercury	7439-97-6	E510C	0.200	mg/kg	<0.200	<0.200	0	Diff <2x LOR	----
Metals (QC Lot: 1998533)											
WT2511423-001	Anonymous	Antimony	7440-36-0	E440C	0.10	mg/kg	0.45	0.46	0.01	Diff <2x LOR	----
		Arsenic	7440-38-2	E440C	0.10	mg/kg	3.88	3.99	2.78%	30%	----
		Barium	7440-39-3	E440C	0.50	mg/kg	155	156	0.707%	40%	----
		Beryllium	7440-41-7	E440C	0.10	mg/kg	0.34	0.35	0.01	Diff <2x LOR	----
		Boron	7440-42-8	E440C	5.0	mg/kg	12.8	13.5	0.6	Diff <2x LOR	----
		Cadmium	7440-43-9	E440C	0.020	mg/kg	0.197	0.250	23.8%	30%	----
		Chromium	7440-47-3	E440C	0.50	mg/kg	19.7	19.2	2.66%	30%	----
		Cobalt	7440-48-4	E440C	0.10	mg/kg	5.30	5.38	1.41%	30%	----
		Copper	7440-50-8	E440C	0.50	mg/kg	16.0	16.4	3.00%	30%	----
		Lead	7439-92-1	E440C	0.50	mg/kg	70.4	57.9	19.5%	40%	----
		Molybdenum	7439-98-7	E440C	0.10	mg/kg	0.61	0.64	4.87%	40%	----
		Nickel	7440-02-0	E440C	0.50	mg/kg	12.1	12.1	0.0713%	30%	----

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 Work Order : WT2511456
 Client : Chung and Vander Doelen Engineering Ltd.
 Project : 2464



Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Metals (QC Lot: 1998533) - continued											
WT2511423-001	Anonymous	Selenium	7782-49-2	E440C	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Silver	7440-22-4	E440C	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
		Thallium	7440-28-0	E440C	0.050	mg/kg	0.119	0.118	0.001	Diff <2x LOR	----
		Uranium	7440-61-1	E440C	0.050	mg/kg	0.329	0.343	4.17%	30%	----
		Vanadium	7440-62-2	E440C	0.20	mg/kg	20.8	21.7	4.14%	30%	----
		Zinc	7440-66-6	E440C	2.0	mg/kg	139	142	2.22%	30%	----
Metals (QC Lot: 1998849)											
WT2511456-002	BH2-SA2	Calcium, soluble ion content	7440-70-2	E484	0.50	mg/L	4.14	4.41	6.32%	30%	----
		Magnesium, soluble ion content	7439-95-4	E484	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Sodium, soluble ion content	17341-25-2	E484	0.50	mg/L	63.7	68.0	6.53%	30%	----
Metals (QC Lot: 1998851)											
WT2511456-002	BH2-SA2	Boron, hot water soluble	7440-42-8	E487	0.10	mg/kg	0.35	0.34	0.01	Diff <2x LOR	----
Metals (QC Lot: 1998852)											
WT2511456-002	BH2-SA2	Mercury	7439-97-6	E510C	0.0050	mg/kg	<0.0050	<0.0050	0	Diff <2x LOR	----
Metals (QC Lot: 1998853)											
WT2511456-002	BH2-SA2	Antimony	7440-36-0	E440C	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
		Arsenic	7440-38-2	E440C	0.10	mg/kg	1.25	1.31	4.41%	30%	----
		Barium	7440-39-3	E440C	0.50	mg/kg	9.27	8.87	4.47%	40%	----
		Beryllium	7440-41-7	E440C	0.10	mg/kg	0.10	0.12	0.01	Diff <2x LOR	----
		Boron	7440-42-8	E440C	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Cadmium	7440-43-9	E440C	0.020	mg/kg	0.127	0.129	0.002	Diff <2x LOR	----
		Chromium	7440-47-3	E440C	0.50	mg/kg	5.97	6.03	1.01%	30%	----
		Cobalt	7440-48-4	E440C	0.10	mg/kg	1.59	1.60	0.617%	30%	----
		Copper	7440-50-8	E440C	0.50	mg/kg	4.16	3.95	5.22%	30%	----
		Lead	7439-92-1	E440C	0.50	mg/kg	6.88	7.23	5.04%	40%	----
		Molybdenum	7439-98-7	E440C	0.10	mg/kg	0.19	0.18	0.005	Diff <2x LOR	----
		Nickel	7440-02-0	E440C	0.50	mg/kg	3.13	2.96	0.17	Diff <2x LOR	----
		Selenium	7782-49-2	E440C	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Silver	7440-22-4	E440C	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
		Thallium	7440-28-0	E440C	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		Uranium	7440-61-1	E440C	0.050	mg/kg	0.299	0.379	23.7%	30%	----
		Vanadium	7440-62-2	E440C	0.20	mg/kg	15.7	16.1	2.55%	30%	----
		Zinc	7440-66-6	E440C	2.0	mg/kg	41.8	40.1	3.95%	30%	----
Speciated Metals (QC Lot: 1997599)											



Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Speciated Metals (QC Lot: 1997599) - continued											
WT2511371-001	Anonymous	Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.10	mg/kg	0.31	0.34	0.04	Diff <2x LOR	----
Volatile Organic Compounds (QC Lot: 1999618)											
WT2511365-001	Anonymous	Benzene	71-43-2	E611A	0.0050	mg/kg	<0.0050 µg/g	<0.0050	0	Diff <2x LOR	----
		Ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015 µg/g	<0.015	0	Diff <2x LOR	----
		Toluene	108-88-3	E611A	0.050	mg/kg	<0.050 µg/g	<0.050	0	Diff <2x LOR	----
		Xylene, m+p-	179601-23-1	E611A	0.030	mg/kg	<0.030 µg/g	<0.030	0	Diff <2x LOR	----
		Xylene, o-	95-47-6	E611A	0.030	mg/kg	<0.030 µg/g	<0.030	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 1997597)											
WT2511371-001	Anonymous	F2 (C10-C16)	----	E601.SG-L	10	mg/kg	<10 µg/g	<10	0	Diff <2x LOR	----
		F3 (C16-C34)	----	E601.SG-L	50	mg/kg	<50 µg/g	<50	0	Diff <2x LOR	----
		F4 (C34-C50)	----	E601.SG-L	50	mg/kg	<50 µg/g	<50	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 1999619)											
WT2511365-001	Anonymous	F1 (C6-C10)	----	E581.F1	5.0	mg/kg	<5.0 µg/g	<5.0	0	Diff <2x LOR	----



Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Soil/Solid

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1997600)						
Moisture	----	E144	0.25	%	<0.25	----
Physical Tests (QCLot: 1998529)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Physical Tests (QCLot: 1998850)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Cyanides (QCLot: 1997598)						
Cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	<0.050	----
Metals (QCLot: 1998530)						
Calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	<0.50	----
Magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	<0.50	----
Sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	<0.50	----
Metals (QCLot: 1998531)						
Boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	<0.10	----
Metals (QCLot: 1998532)						
Mercury	7439-97-6	E510C	0.005	mg/kg	<0.0050	----
Metals (QCLot: 1998533)						
Antimony	7440-36-0	E440C	0.1	mg/kg	<0.10	----
Arsenic	7440-38-2	E440C	0.1	mg/kg	<0.10	----
Barium	7440-39-3	E440C	0.5	mg/kg	<0.50	----
Beryllium	7440-41-7	E440C	0.1	mg/kg	<0.10	----
Boron	7440-42-8	E440C	5	mg/kg	<5.0	----
Cadmium	7440-43-9	E440C	0.02	mg/kg	<0.020	----
Chromium	7440-47-3	E440C	0.5	mg/kg	<0.50	----
Cobalt	7440-48-4	E440C	0.1	mg/kg	<0.10	----
Copper	7440-50-8	E440C	0.5	mg/kg	<0.50	----
Lead	7439-92-1	E440C	0.5	mg/kg	<0.50	----
Molybdenum	7439-98-7	E440C	0.1	mg/kg	<0.10	----
Nickel	7440-02-0	E440C	0.5	mg/kg	<0.50	----
Selenium	7782-49-2	E440C	0.2	mg/kg	<0.20	----
Silver	7440-22-4	E440C	0.1	mg/kg	<0.10	----
Thallium	7440-28-0	E440C	0.05	mg/kg	<0.050	----
Uranium	7440-61-1	E440C	0.05	mg/kg	<0.050	----



Sub-Matrix: Soil/Solid

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 1998533) - continued						
Vanadium	7440-62-2	E440C	0.2	mg/kg	<0.20	----
Zinc	7440-66-6	E440C	2	mg/kg	<2.0	----
Metals (QCLot: 1998849)						
Calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	<0.50	----
Magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	<0.50	----
Sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	<0.50	----
Metals (QCLot: 1998851)						
Boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	<0.10	----
Metals (QCLot: 1998852)						
Mercury	7439-97-6	E510C	0.005	mg/kg	<0.0050	----
Metals (QCLot: 1998853)						
Antimony	7440-36-0	E440C	0.1	mg/kg	<0.10	----
Arsenic	7440-38-2	E440C	0.1	mg/kg	<0.10	----
Barium	7440-39-3	E440C	0.5	mg/kg	<0.50	----
Beryllium	7440-41-7	E440C	0.1	mg/kg	<0.10	----
Boron	7440-42-8	E440C	5	mg/kg	<5.0	----
Cadmium	7440-43-9	E440C	0.02	mg/kg	<0.020	----
Chromium	7440-47-3	E440C	0.5	mg/kg	<0.50	----
Cobalt	7440-48-4	E440C	0.1	mg/kg	<0.10	----
Copper	7440-50-8	E440C	0.5	mg/kg	<0.50	----
Lead	7439-92-1	E440C	0.5	mg/kg	<0.50	----
Molybdenum	7439-98-7	E440C	0.1	mg/kg	<0.10	----
Nickel	7440-02-0	E440C	0.5	mg/kg	<0.50	----
Selenium	7782-49-2	E440C	0.2	mg/kg	<0.20	----
Silver	7440-22-4	E440C	0.1	mg/kg	<0.10	----
Thallium	7440-28-0	E440C	0.05	mg/kg	<0.050	----
Uranium	7440-61-1	E440C	0.05	mg/kg	<0.050	----
Vanadium	7440-62-2	E440C	0.2	mg/kg	<0.20	----
Zinc	7440-66-6	E440C	2	mg/kg	<2.0	----
Speciated Metals (QCLot: 1997599)						
Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	<0.10	----
Volatile Organic Compounds (QCLot: 1999618)						
Benzene	71-43-2	E611A	0.005	mg/kg	<0.0050	----
Ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	----
Toluene	108-88-3	E611A	0.05	mg/kg	<0.050	----



Sub-Matrix: Soil/Solid

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Volatile Organic Compounds (QCLot: 1999618) - continued						
Xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	<0.030	----
Xylene, o-	95-47-6	E611A	0.03	mg/kg	<0.030	----
Hydrocarbons (QCLot: 1997597)						
F2 (C10-C16)	----	E601.SG-L	10	mg/kg	<10	----
F3 (C16-C34)	----	E601.SG-L	50	mg/kg	<50	----
F4 (C34-C50)	----	E601.SG-L	50	mg/kg	<50	----
Hydrocarbons (QCLot: 1999619)						
F1 (C6-C10)	----	E581.F1	5	mg/kg	<5.0	----
Hydrocarbons (QCLot: 2009160)						
F4G-sg	----	E601.F4G-L	250	mg/kg	<250	----



Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Soil/Solid					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		Qualifier
					Target Concentration	LCS	Low	High	
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1996545)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 1997600)									
Moisture	----	E144	0.25	%	50 %	99.8	90.0	110	----
Physical Tests (QCLot: 1998529)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1410 µS/cm	100	90.0	110	----
Physical Tests (QCLot: 1998850)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1410 µS/cm	97.7	90.0	110	----
Cyanides (QCLot: 1997598)									
Cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	1.25 mg/kg	88.6	80.0	120	----
Metals (QCLot: 1998530)									
Calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	300 mg/L	106	80.0	120	----
Magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	50 mg/L	102	80.0	120	----
Sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	50 mg/L	98.8	80.0	120	----
Metals (QCLot: 1998531)									
Boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	2 mg/kg	103	70.0	130	----
Metals (QCLot: 1998532)									
Mercury	7439-97-6	E510C	0.005	mg/kg	0.1 mg/kg	100	80.0	120	----
Metals (QCLot: 1998533)									
Antimony	7440-36-0	E440C	0.1	mg/kg	100 mg/kg	94.3	80.0	120	----
Arsenic	7440-38-2	E440C	0.1	mg/kg	100 mg/kg	102	80.0	120	----
Barium	7440-39-3	E440C	0.5	mg/kg	25 mg/kg	106	80.0	120	----
Beryllium	7440-41-7	E440C	0.1	mg/kg	10 mg/kg	97.8	80.0	120	----
Boron	7440-42-8	E440C	5	mg/kg	100 mg/kg	99.8	80.0	120	----
Cadmium	7440-43-9	E440C	0.02	mg/kg	10 mg/kg	99.0	80.0	120	----
Chromium	7440-47-3	E440C	0.5	mg/kg	25 mg/kg	100	80.0	120	----
Cobalt	7440-48-4	E440C	0.1	mg/kg	25 mg/kg	99.3	80.0	120	----
Copper	7440-50-8	E440C	0.5	mg/kg	25 mg/kg	97.7	80.0	120	----
Lead	7439-92-1	E440C	0.5	mg/kg	50 mg/kg	97.7	80.0	120	----
Molybdenum	7439-98-7	E440C	0.1	mg/kg	25 mg/kg	98.1	80.0	120	----
Nickel	7440-02-0	E440C	0.5	mg/kg	50 mg/kg	99.0	80.0	120	----



Sub-Matrix: Soil/Solid					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		Qualifier
					Target Concentration	LCS	Low	High	
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Metals (QCLot: 1998533) - continued									
Selenium	7782-49-2	E440C	0.2	mg/kg	100 mg/kg	96.6	80.0	120	----
Silver	7440-22-4	E440C	0.1	mg/kg	10 mg/kg	86.4	80.0	120	----
Thallium	7440-28-0	E440C	0.05	mg/kg	100 mg/kg	96.2	80.0	120	----
Uranium	7440-61-1	E440C	0.05	mg/kg	0.5 mg/kg	94.2	80.0	120	----
Vanadium	7440-62-2	E440C	0.2	mg/kg	50 mg/kg	103	80.0	120	----
Zinc	7440-66-6	E440C	2	mg/kg	50 mg/kg	97.7	80.0	120	----
Metals (QCLot: 1998849)									
Calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	300 mg/L	104	80.0	120	----
Magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	50 mg/L	99.4	80.0	120	----
Sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	50 mg/L	96.4	80.0	120	----
Metals (QCLot: 1998851)									
Boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	2 mg/kg	102	70.0	130	----
Metals (QCLot: 1998852)									
Mercury	7439-97-6	E510C	0.005	mg/kg	0.1 mg/kg	102	80.0	120	----
Metals (QCLot: 1998853)									
Antimony	7440-36-0	E440C	0.1	mg/kg	100 mg/kg	95.6	80.0	120	----
Arsenic	7440-38-2	E440C	0.1	mg/kg	100 mg/kg	103	80.0	120	----
Barium	7440-39-3	E440C	0.5	mg/kg	25 mg/kg	103	80.0	120	----
Beryllium	7440-41-7	E440C	0.1	mg/kg	10 mg/kg	97.5	80.0	120	----
Boron	7440-42-8	E440C	5	mg/kg	100 mg/kg	97.6	80.0	120	----
Cadmium	7440-43-9	E440C	0.02	mg/kg	10 mg/kg	96.8	80.0	120	----
Chromium	7440-47-3	E440C	0.5	mg/kg	25 mg/kg	98.4	80.0	120	----
Cobalt	7440-48-4	E440C	0.1	mg/kg	25 mg/kg	96.5	80.0	120	----
Copper	7440-50-8	E440C	0.5	mg/kg	25 mg/kg	94.4	80.0	120	----
Lead	7439-92-1	E440C	0.5	mg/kg	50 mg/kg	97.6	80.0	120	----
Molybdenum	7439-98-7	E440C	0.1	mg/kg	25 mg/kg	97.3	80.0	120	----
Nickel	7440-02-0	E440C	0.5	mg/kg	50 mg/kg	96.4	80.0	120	----
Selenium	7782-49-2	E440C	0.2	mg/kg	100 mg/kg	98.0	80.0	120	----
Silver	7440-22-4	E440C	0.1	mg/kg	10 mg/kg	84.4	80.0	120	----
Thallium	7440-28-0	E440C	0.05	mg/kg	100 mg/kg	96.0	80.0	120	----
Uranium	7440-61-1	E440C	0.05	mg/kg	0.5 mg/kg	93.3	80.0	120	----
Vanadium	7440-62-2	E440C	0.2	mg/kg	50 mg/kg	100	80.0	120	----
Zinc	7440-66-6	E440C	2	mg/kg	50 mg/kg	95.1	80.0	120	----
Speciated Metals (QCLot: 1997599)									
Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	0.8 mg/kg	107	80.0	120	----



Sub-Matrix: Soil/Solid					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 1999618)									
Benzene	71-43-2	E611A	0.005	mg/kg	3.48 mg/kg	99.9	70.0	130	----
Ethylbenzene	100-41-4	E611A	0.015	mg/kg	3.48 mg/kg	91.6	70.0	130	----
Toluene	108-88-3	E611A	0.05	mg/kg	3.48 mg/kg	97.0	70.0	130	----
Xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	6.95 mg/kg	88.1	70.0	130	----
Xylene, o-	95-47-6	E611A	0.03	mg/kg	3.48 mg/kg	87.0	70.0	130	----
Hydrocarbons (QCLot: 1997597)									
F2 (C10-C16)	----	E601.SG-L	10	mg/kg	671 mg/kg	106	70.0	130	----
F3 (C16-C34)	----	E601.SG-L	50	mg/kg	1380 mg/kg	104	70.0	130	----
F4 (C34-C50)	----	E601.SG-L	50	mg/kg	748 mg/kg	106	70.0	130	----
Hydrocarbons (QCLot: 1999619)									
F1 (C6-C10)	----	E581.F1	5	mg/kg	69.2 mg/kg	94.9	80.0	120	----
Hydrocarbons (QCLot: 2009160)									
F4G-sg	----	E601.F4G-L	250	mg/kg	1300 mg/kg	99.9	70.0	130	----



Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: Soil/Solid

Sub-Matrix: Soil/Solid					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Cyanides (QCLot: 1997598)										
WT2511371-001	Anonymous	Cyanide, weak acid dissociable	----	E336A	1.14 mg/kg	1.24 mg/kg	91.8	70.0	130	----
Volatile Organic Compounds (QCLot: 1999618)										
WT2511365-001	Anonymous	Benzene	71-43-2	E611A	2.22 mg/kg	2.02 mg/kg	110	60.0	140	----
		Ethylbenzene	100-41-4	E611A	2.00 mg/kg	2.02 mg/kg	99.5	60.0	140	----
		Toluene	108-88-3	E611A	2.16 mg/kg	2.02 mg/kg	107	60.0	140	----
		Xylene, m+p-	179601-23-1	E611A	3.95 mg/kg	4.03 mg/kg	97.9	60.0	140	----
		Xylene, o-	95-47-6	E611A	1.97 mg/kg	2.02 mg/kg	97.7	60.0	140	----
Hydrocarbons (QCLot: 1997597)										
WT2511371-001	Anonymous	F2 (C10-C16)	----	E601.SG-L	544 mg/kg	514 mg/kg	106	60.0	140	----
		F3 (C16-C34)	----	E601.SG-L	1170 mg/kg	1060 mg/kg	110	60.0	140	----
		F4 (C34-C50)	----	E601.SG-L	657 mg/kg	573 mg/kg	115	60.0	140	----
Hydrocarbons (QCLot: 1999619)										
WT2511365-001	Anonymous	F1 (C6-C10)	----	E581.F1	40.6 mg/kg	40.3 mg/kg	101	60.0	140	----



Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

Sub-Matrix:					Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
							Low	High	
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method					
Physical Tests (QCLot: 1998529)									
QC-1998529-003	RM	Conductivity (1:2 leachate)	----	E100-L	3130 µS/cm	98.6	70.0	130	----
Physical Tests (QCLot: 1998850)									
QC-1998850-003	RM	Conductivity (1:2 leachate)	----	E100-L	3130 µS/cm	94.5	70.0	130	----
Metals (QCLot: 1998530)									
QC-1998530-003	RM	Calcium, soluble ion content	7440-70-2	E484	169 mg/L	101	70.0	130	----
QC-1998530-003	RM	Magnesium, soluble ion content	7439-95-4	E484	60.4 mg/L	99.4	70.0	130	----
QC-1998530-003	RM	Sodium, soluble ion content	17341-25-2	E484	107 mg/L	98.3	70.0	130	----
Metals (QCLot: 1998531)									
QC-1998531-003	RM	Boron, hot water soluble	7440-42-8	E487	1.82 mg/kg	113	60.0	140	----
Metals (QCLot: 1998532)									
QC-1998532-003	RM	Mercury	7439-97-6	E510C	0.068 mg/kg	98.4	70.0	130	----
Metals (QCLot: 1998533)									
QC-1998533-003	RM	Antimony	7440-36-0	E440C	24.8 mg/kg	85.1	70.0	130	----
QC-1998533-003	RM	Arsenic	7440-38-2	E440C	21.2 mg/kg	95.2	70.0	130	----
QC-1998533-003	RM	Barium	7440-39-3	E440C	788 mg/kg	105	70.0	130	----
QC-1998533-003	RM	Beryllium	7440-41-7	E440C	1.82 mg/kg	94.2	70.0	130	----
QC-1998533-003	RM	Cadmium	7440-43-9	E440C	2.15 mg/kg	97.1	70.0	130	----
QC-1998533-003	RM	Chromium	7440-47-3	E440C	56.9 mg/kg	98.0	70.0	130	----
QC-1998533-003	RM	Cobalt	7440-48-4	E440C	32 mg/kg	97.6	70.0	130	----
QC-1998533-003	RM	Copper	7440-50-8	E440C	969 mg/kg	102	70.0	130	----
QC-1998533-003	RM	Lead	7439-92-1	E440C	919 mg/kg	92.2	70.0	130	----
QC-1998533-003	RM	Molybdenum	7439-98-7	E440C	25.1 mg/kg	96.5	70.0	130	----
QC-1998533-003	RM	Nickel	7440-02-0	E440C	1000 mg/kg	107	70.0	130	----
QC-1998533-003	RM	Selenium	7782-49-2	E440C	1.04 mg/kg	105	60.0	140	----
QC-1998533-003	RM	Silver	7440-22-4	E440C	8.98 mg/kg	88.9	70.0	130	----
QC-1998533-003	RM	Thallium	7440-28-0	E440C	0.907 mg/kg	90.4	70.0	130	----
QC-1998533-003	RM	Uranium	7440-61-1	E440C	3.97 mg/kg	81.9	70.0	130	----
QC-1998533-003	RM	Vanadium	7440-62-2	E440C	66.2 mg/kg	100.0	70.0	130	----
QC-1998533-003	RM	Zinc	7440-66-6	E440C	828 mg/kg	97.4	70.0	130	----
Metals (QCLot: 1998849)									
QC-1998849-003	RM	Calcium, soluble ion content	7440-70-2	E484	169 mg/L	90.2	70.0	130	----
QC-1998849-003	RM	Magnesium, soluble ion content	7439-95-4	E484	60.4 mg/L	91.4	70.0	130	----



Sub-Matrix:					Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
							Low	High	
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method					
Metals (QCLot: 1998849) - continued									
QC-1998849-003	RM	Sodium, soluble ion content	17341-25-2	E484	107 mg/L	101	70.0	130	----
Metals (QCLot: 1998851)									
QC-1998851-003	RM	Boron, hot water soluble	7440-42-8	E487	1.82 mg/kg	111	60.0	140	----
Metals (QCLot: 1998852)									
QC-1998852-003	RM	Mercury	7439-97-6	E510C	0.068 mg/kg	101	70.0	130	----
Metals (QCLot: 1998853)									
QC-1998853-003	RM	Antimony	7440-36-0	E440C	24.8 mg/kg	92.4	70.0	130	----
QC-1998853-003	RM	Arsenic	7440-38-2	E440C	21.2 mg/kg	96.2	70.0	130	----
QC-1998853-003	RM	Barium	7440-39-3	E440C	788 mg/kg	111	70.0	130	----
QC-1998853-003	RM	Beryllium	7440-41-7	E440C	1.82 mg/kg	102	70.0	130	----
QC-1998853-003	RM	Cadmium	7440-43-9	E440C	2.15 mg/kg	99.0	70.0	130	----
QC-1998853-003	RM	Chromium	7440-47-3	E440C	56.9 mg/kg	98.4	70.0	130	----
QC-1998853-003	RM	Cobalt	7440-48-4	E440C	32 mg/kg	96.9	70.0	130	----
QC-1998853-003	RM	Copper	7440-50-8	E440C	969 mg/kg	103	70.0	130	----
QC-1998853-003	RM	Lead	7439-92-1	E440C	919 mg/kg	94.1	70.0	130	----
QC-1998853-003	RM	Molybdenum	7439-98-7	E440C	25.1 mg/kg	100.0	70.0	130	----
QC-1998853-003	RM	Nickel	7440-02-0	E440C	1000 mg/kg	105	70.0	130	----
QC-1998853-003	RM	Selenium	7782-49-2	E440C	1.04 mg/kg	93.2	60.0	140	----
QC-1998853-003	RM	Silver	7440-22-4	E440C	8.98 mg/kg	91.0	70.0	130	----
QC-1998853-003	RM	Thallium	7440-28-0	E440C	0.907 mg/kg	90.4	70.0	130	----
QC-1998853-003	RM	Uranium	7440-61-1	E440C	3.97 mg/kg	88.4	70.0	130	----
QC-1998853-003	RM	Vanadium	7440-62-2	E440C	66.2 mg/kg	99.7	70.0	130	----
QC-1998853-003	RM	Zinc	7440-66-6	E440C	828 mg/kg	96.4	70.0	130	----
Speciated Metals (QCLot: 1997599)									
QC-1997599-003	RM	Chromium, hexavalent [Cr VI]	18540-29-9	E532	172 mg/kg	94.2	70.0	130	----



50L-922
VS-070

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

COC Number: 20 - 948859

Page of

**Environmental Division
Waterloo**

Work Order Reference
WT2511456

[illegible]

APPENDIX C

COMPARISON OF THE SOIL CHEMISTRY RESULTS TO THE APPLICABLE REGULATORY CRITERIA



ANALYTICAL RESULTS FOR SOIL

Ontario Regulation 406/19 (as amended) - Excess Soil Quality Standards

		T1 RPIIC ¹	T2.1 RPI ²	T2.1 ICC ⁴	BH 1 - SA 1 (0.00 to 0.60 m depth)	BH 2 - SA 2 (0.75 to 1.20 m depth)	BH 3 - SA 1 (0.00 to 0.60 m depth)
Metals & Inorganics	Electrical Conductivity (EC)	0.57	0.7	1.4	0.0994	0.461	0.0879
	pH	-	-	-	7.50	9.90	7.26
	Cyanide	0.051	0.051	0.051	<0.050	<0.050	<0.050
	Sodium Adsorption Ratio (SAR)	2.4	5	12	<0.10	8.62	0.86
	Antimony (Sb)	1.3	7.5	40	<0.10	<0.10	<0.10
	Arsenic (As)	18	18	18	2.24	1.25	1.21
	Barium (Ba)	220	390	670	19.8	9.27	14.2
	Beryllium (Be)	2.5	4	8	0.24	0.10	0.18
	Boron (B)	36	120	120	<5.0	<5.0	<5.0
	Boron, Hot Water Soluble	-	1.5	2	<0.10	0.35	<0.10
	Cadmium (Cd)	1.2	1.2	1.9	0.143	0.127	0.096
	Chromium (Cr)	70	160	160	8.64	5.97	6.22
	Cobalt (Co)	21	22	80	2.57	1.59	2.11
	Copper (Cu)	92	140	230	5.28	4.16	2.64
	Lead (Pb)	120	120	120	6.00	6.88	4.63
	Molybdenum (Mo)	2	6.9	40	<0.200	<0.0050	0.0090
	Mercury (Hg)	0.27	0.27	0.27	0.15	0.19	0.11
	Nickel (Ni)	82	100	270	5.77	3.13	3.98
	Selenium (Se)	1.5	2.4	5.5	<0.20	<0.20	<0.20
	Silver (Ag)	0.5	20	40	<0.10	<0.10	<0.10
	Thallium (Tl)	1	1	3.3	<0.050	<0.050	<0.050
	Uranium (U)	2.5	23	33	0.379	0.299	0.230
	Vanadium (V)	86	86	86	16.9	15.7	13.4
	Zinc (Zn)	290	340	340	31.4	41.8	24.6
	Chromium, Hexavalent - Cr(VI)	0.66	8	8	0.18	<0.10	0.19
BTEX	Benzene	0.02	0.02	0.02	<0.0050	<0.0050	<0.0050
	Ethylbenzene	0.05	0.05	0.05	<0.015	<0.015	<0.015
	Toluene	0.2	0.2	0.2	<0.050	<0.050	<0.050
	Xylenes (Total)	0.05	0.091	0.091	<0.050	<0.050	<0.050
Petroleum Hydrocarbons (F1-F4)	F1 (C6-C10)	25	25	25	<5.0	<5.0	<5.0
	F2 (C10-C16)	10	10	26	<10	<10	<10
	F3 (C16-C34)	240	240	240	<50	113	<50
	F4 (C34-C50)	120	2800	3300	<50	240	<50
	F4G-SG (GHH-Silica)	120	2800	3300	-	760	-

NOTES:

¹ Table 1: Full Depth Background Site Condition Standards for Residential / Parkland / Institutional / Industrial / Commercial / Community Uses

² Table 2.1: Full Depth Excess Soil Quality Standards in a Potable Ground Water Condition (Volume Independent) for Residential / Parkland / Institutional Uses

³ Table 2.1: Full Depth Excess Soil Quality Standards in a Potable Ground Water Condition (Volume Independent) for Industrial / Commercial / Community Uses

1. Units = ug/g (excluding pH/EC/SAR)

2. "-,-" = Parameter not included in chemical analysis

3. Test results exceed Table 1 RPIICC ESQS

4. Test results exceed Table 2.1 RPI ESQS

5. Test results exceed Table 2.1 ICC ESQS

ENCLOSURES



Soil Abbreviations and Terms Used on Record of Borehole Sheets

TERMINOLOGY DESCRIBING COMMON SOIL TYPES:

Topsoil	-	mixture of soil and humus capable of supporting vegetation
Peat	-	mixture of visible and invisible fragments of decayed organic matter
Till	-	unstratified glacial deposit which may range from clay to boulders
Fill	-	soil materials identified as being placed anthropologically

CLASSIFICATION (UNIFIED SYSTEM)

Clay	<0.002mm	
Silt	0.002 to .075mm	
Sand	0.075 to 4.75mm	
	Fine	0.075 to 0.425 mm
	Medium	0.425 to 2.0 mm
	Coarse	2.0 to 4.75 mm
Gravel	4.75 to 75mm	
	Fine	4.75 to 19 mm
	Coarse	19 to 75 mm
Cobbles	75 to 300mm	
Boulders	>300mm	

TERMINOLOGY

Soil Composition	% by Weight
"traces"	<10%
"some"(eg. some silt)	10-20%
Adjective (eg. sandy)	20-35%
"and"(eg. sand and gravel)	35-50%

Standard Penetration Resistance (SPT): Standard Penetration Resistance ('N' Values) refers to the number of blows required to advance a standard (ASTM D1586) 51 mm Ø (2 inch) split-spoon sampler by the use of a free falling, 63.5 Kg (140lbs) hammer. The number of blows from the drop weight is recorded for every 15 cm (6 inches). The hammer is dropped from a distance of 0.76m (30 inches) providing 474.5 Joules per blow. When the sampler is driven a total of 45 cm (18 inches) into the soil, the standard penetration index ('N' Value) is the total number of blows for the last 30 cm (12 inches).

Dynamic Cone Penetration Resistance (DCPT): Dynamic Cone Penetration Resistance is similar to a SPT with the 474.5 Joule/blow impulse provided by the free falling hammer where the split-spoon sampler is replaced by a 51 mm Ø, 60° conical point and the number of blows is recorded continuously for every 30 cm (12 inches).

COHESIVE SOILS CONSISTENCY

	(kPa)	(P.S.F.)	Nominal 'N' Value
Very Soft	<12	<250	0-2
Soft	12-25	250-500	2-4
Firm	25-50	500-1000	4-8
Stiff	50-100	1000-2000	8-15
Very Stiff	100-200	2000-4000	15-30
Hard	>200	>4000	>30

RELATIVE DENSITY OF COHESIONLESS SOIL

	'N' Value
Very Loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

MOISTURE CONDITIONS:

Cohesive Soil
DTPL- Drier than plastic limit
APL- About plastic limit
WTPL- Wetter than plastic limit
MWTPL- Much wetter than plastic limit

Cohesionless Soil
Damp
Moist
Wet
Saturated

SAMPLE TYPES AND ADDITIONAL FIELD TESTS

SS	Split Spoon Sample (obtained from SPT)	GS	Grab Sample	PP	Pocket Penetrometer
AS	Auger Sample	BS	Bulk Sample	VANE	Peak & Remolded shear
		TW	Thin Wall Sample or Shelby Tube	DMT	Flat Plate Dilatometer

LABORATORY TESTS

SG	Specific Gravity	S	Sieve Analysis	W	Water Content
H	Hydrometer	P	Field Permeability	K	Lab Permeability
W_p	Plastic Limit	W_l	Liquid Limit	I_p	Plasticity Index
GSA	Grain Size Analysis	C	Consolidation	UNC	Unconfined compression

FILE No: 2464**BOREHOLE No. 1**Client: **Waterloo Catholic District School Board**Project: **Proposed Building Addition**Location: **504 Connaught Street, Kitchener, Ontario****EQUIPMENT DATA**

Machine: **Geoprobe**
 Method: **Hollow Stem Auger**
 Size: **83 mm I.D**
 Date: **May 09 - 25 TO May 09 - 25**

SOIL LITHOLOGY				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _P W W _L ↔ ○ ↔					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80									
325.74 0.18	Ground Elevation: 325.92 m 175 mm GRANULAR FILL															
324.22 1.70	loose brown to dark brown FILL, silty sand to sand and silt trace gravel moist ----- contains asphalt fragments	0.5		1	SS	5	●						○			
				2	SS	5	●						○			
				3	SS	27										
	compact brown Fine to Medium SAND trace to some silt trace gravel occ. silt layers damp to moist	2.0														
				4	SS	18							○			
		3.0														
				5	SS	11							○			
		3.5														
				6	SS	14							○			
		4.0														
		4.5														
				7	SS	11							○			
320.92 5.00	End of Borehole	5.0														

dry soil cave-in at 4.0 m
depth upon withdrawal of
drilling augers

PROJECT MANAGER: **NZ**

**CHUNG & VANDER DOELEN
ENGINEERING LTD.**

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 Kitchener, Ontario N2H 5E1
 ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 2464**BOREHOLE No. 2**Client: **Waterloo Catholic District School Board**Project: **Proposed Building Addition**Location: **504 Connaught Street, Kitchener, Ontario****EQUIPMENT DATA**

Machine: **Geoprobe**
 Method: **Hollow Stem Auger**
 Size: **83 mm I.D**
 Date: **May 09 - 25 TO May 09 - 25**

SOIL LITHOLOGY			SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS		
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L ↗ — ○ ↖						
Ground Elevation: 326.96 m							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30						
326.61 0.35	100 mm ASPHALT 250 mm GRANULAR BASE	0.5		1	SS	8	●										
325.91 1.05	loose, dark brown to brown FILL, sand and silt trace gravel contains asphalt fragments moist	1.0		2	SS	4	●										
	loose to compact brown Fine to Medium SAND trace gravel, trace silt damp to moist	1.5															
2.0		3		SS	13	●											
2.5																	
3.0		4		SS	14	●											
3.5																	
4.0		5		SS	26	●											
4.5																	
321.96 5.00	End of Borehole	5.0		7	SS	24	●										
		5.5															
		6.0															
		6.5															
		7.0															
		7.5															

dry soil cave-in at 4.0 m
depth upon withdrawal of
drilling augers

PROJECT MANAGER: **NZ**

**CHUNG & VANDER DOELEN
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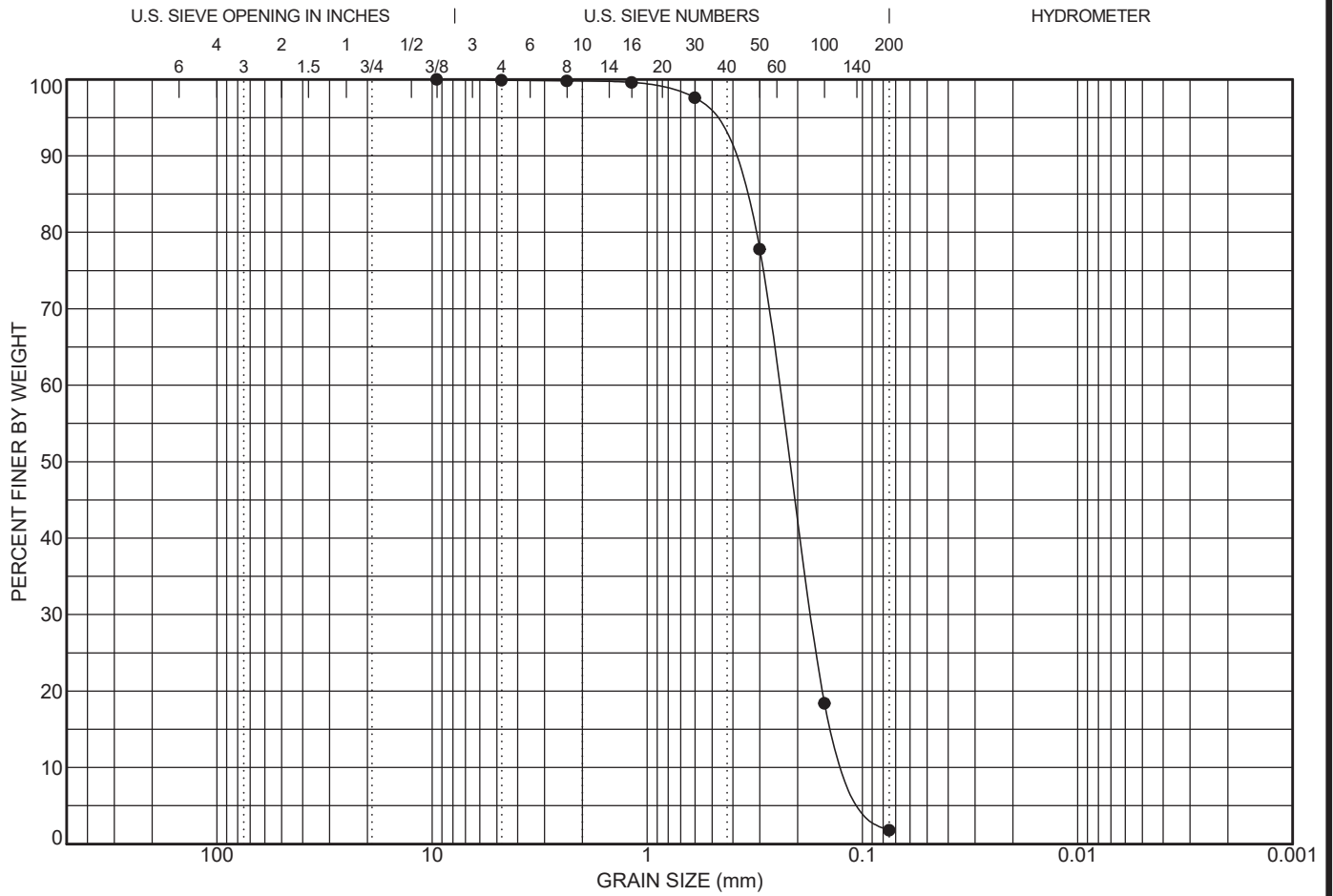
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FILE No: 2464**BOREHOLE No. 3**Client: **Waterloo Catholic District School Board**Project: **Proposed Building Addition**Location: **504 Connaught Street, Kitchener, Ontario****EQUIPMENT DATA**Machine: **Geoprobe**Method: **Hollow Stem Auger**Size: **83 mm I.D**Date: **May 09 - 25 TO May 09 - 25**

SOIL LITHOLOGY				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS			
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L ↔○↔								
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80												
323.66 2.20	25 mm TOPSOIL 100 mm GRANULAR FILL very loose brown to dark brown FILL, sand and silt trace gravel occ. sand layers occ. clayey silt seams/layers moist to saturated	0.5		1	SS	3	●							○			0.5		
															○			1.0	
																		1.5	
					3	SS	WH									○			2.0
																			2.5
					4	SS	19	●							○				3.0
																			3.5
320.86 5.00	compact to dense brown Fine to Medium SAND trace to some silt damp to moist	3.5		5	SS	11	●							○				4.0	
		4.0		6	SS	32								○				4.5	
		4.5																5.0	
				7	SS	11	●							○				5.5	
End of Borehole		5.0																6.0	
		5.5																6.5	
		6.0																7.0	
		6.5																7.5	
		7.0																8.0	
		7.5																8.5	

dry soil cave-in at 4.25 m depth upon withdrawal of drilling augers

dry soil cave-in at 4.25 m
depth upon withdrawal of
drilling augersPROJECT MANAGER: **NZ****CHUNG & VANDER DOELEN
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Kitchener, Ontario N2H 5E1
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			1.15	2.31	9.5	0.244	0.172	0.106	0.1	98.1		1.8

Date: May. 20 - 2025
Client: Waterloo Catholic District School Board
Contractor:
Source:
Sampled From: BH 3 - SA 5; 3.05 to 3.50 m depth
Sample No.: 3-5
Date Sampled: May. 09 - 2025
Sampled By: DS
Lab No.: 463
Date Tested: May. 13 - 2025
Type of Material: Fine Sand, trace silt

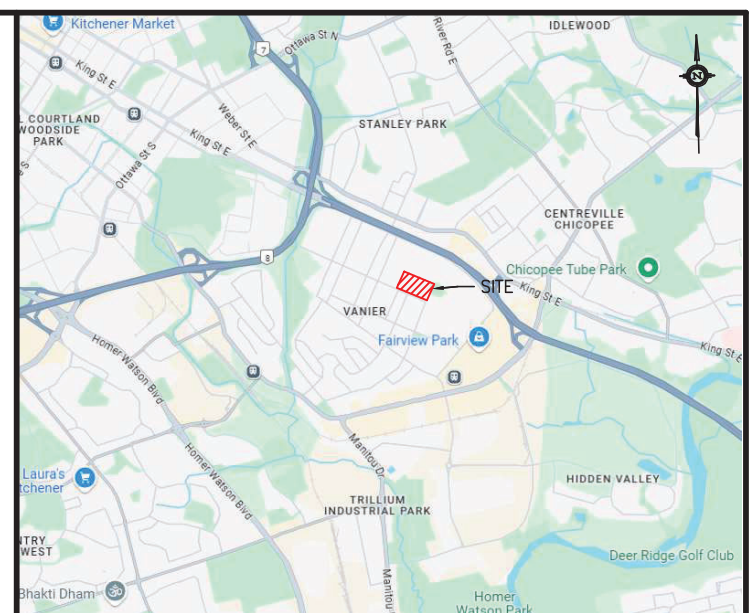
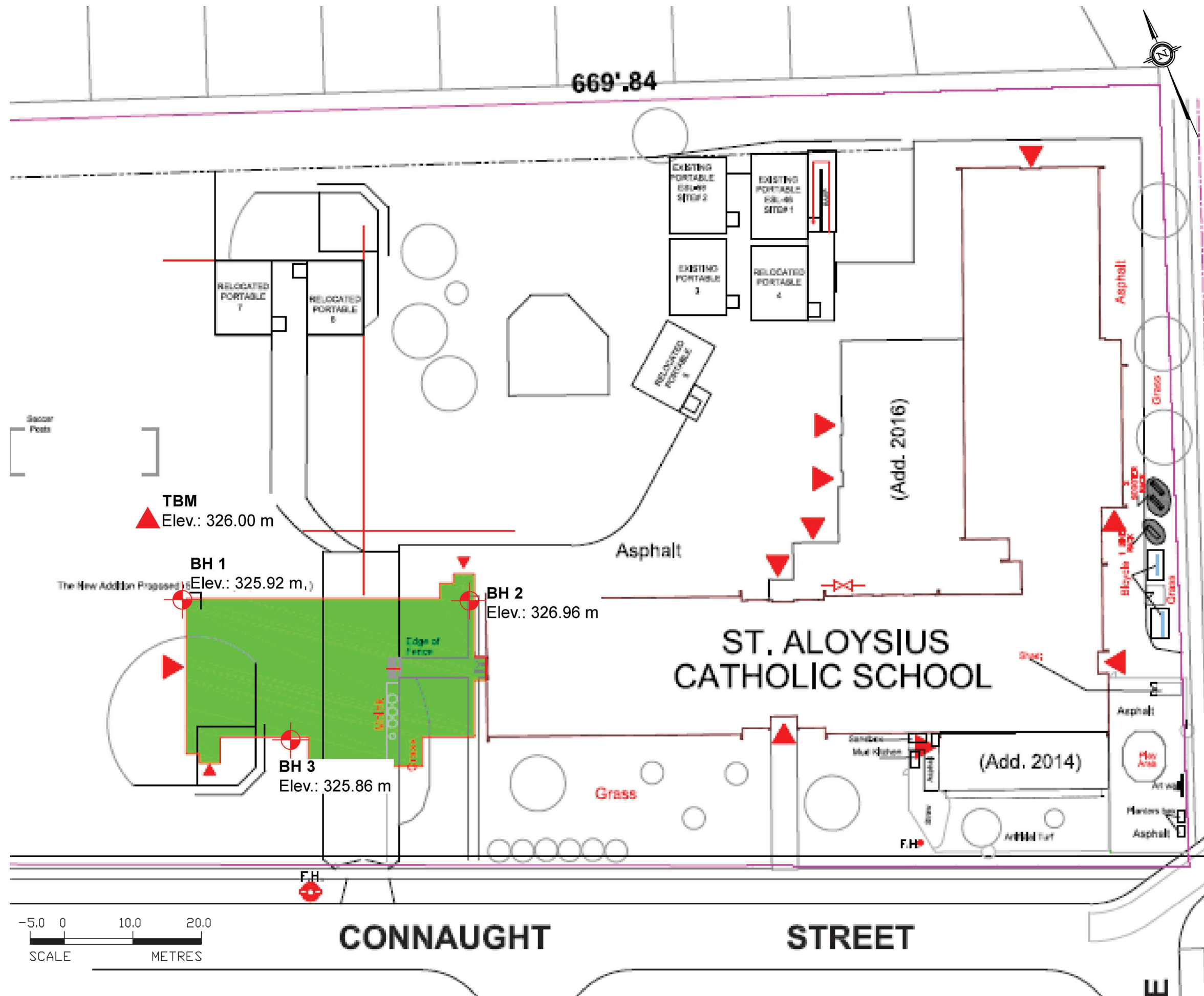
Sieve Size (mm)	Percent Passing	No Specifications



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 e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

Project: Proposed Building Addition
Location: 504 Connaught Street, Kitchener, Ontario
File No.: 2464
Enclosure No.: 4



KEY PLAN SOURCE: Google Earth

LEGEND

- TBM: Top of manhole in grass area, just north of the existing baseball playground
Elevation: 326.00 m (Geodetic)
- Borehole Location

Elev. Ref.: The borehole locations and associated ground surface elevations were surveyed using a Network RTK Global Navigation Satellite System (GNSS) Receiver. The survey data was collected using UTM Zone 17N Projection, NAD83(CRS) v7-2010 datum and Canada Geoid Model HT2_2010v70 (CGVD28).

DWG. Ref.: Waterloo Catholic District School Board; "Appendix C - Site Plan Layout (New)"; St Aloysius Catholic Elementary School, 504 Connaught St, Kitchener, Ontario.

BOREHOLE LOCATION PLAN

Proposed Building Addition

504 Connaught Street
Kitchener, Ontario

CHUNG & VANDER DOELEN
ENGINEERING LTD.

311 VICTORIA STREET NORTH
KITCHENER / ONTARIO / N2H 5E1 / 519-742-8979

Drawn By: DS	Date: May 2025	File No.: 2464
Checked By: NZ	Scale: 1:500	Drawing No.: 1

1.1 WORK OF THIS CONTRACT

- .1 Work of this Contract comprises the following:
Construction of a 10-classroom addition to St. Aloysius CES combined with interior renovations to a portion of the main floor area of the existing school.
Located at:
504 Connaught Street, Kitchener, Ontario, N2C 1C2
And is further identified as: Project No. 2025-06

1.2 DIVISION OF WORK

- .1 Division of the Work among Subcontractors and Suppliers is solely Contractor's responsibility. Consultant and Owner assume no responsibility to act subcontract limits between Sections or Divisions of the Work.

1.3 SPECIFICATIONS LANGUAGE AND STYLE

- .1 Specifications are written in imperative mood and in streamlined form. 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".

1.4 SPECIFICATIONS MEASUREMENTS AND DIMENSIONS

- .1 Specifications are written using SI metric measurements and dimensions.
- .2 This does not preclude the use of Products manufactured or produced to Imperial measurements.
- .3 It remains Contractor's responsibility to make the various parts of the Project come together properly and neatly in a complete manner, in accordance with Contract Documents.

1.5 CONTRACT DOCUMENTS FOR CONSTRUCTION PURPOSES

- .1 Contract Documents were prepared by Consultant for the account of Owner. Information contained in Contract Documents reflects Consultant's best judgement in light of the information available to them at the time of preparation. Any use which a third party makes of Contract Documents, or any reliance on or decisions to be made based on them, are the responsibility of such third parties. Consultant accepts no responsibility for damages, if any,

suffered by any third party because of decisions made or actions based on Contract Documents.

- .2 Owner will supply Contractor with a complete set of Contract Documents in electronic form before commencement of the Work. Contractor may print hard copies for construction purposes as required.

1.6 DOCUMENTS AT PLACE OF THE WORK

- .1 Keep the following documents at Place of the Work, stored securely and in good order and available to Owner and Consultant in both hard copy and electronic formats.
 - .1 Current Contract Documents, including Drawings, Specifications, addenda, bid revisions and Notices in Writing.
 - .2 Proposed changes, Change Orders, Change Directives and Supplemental Instructions.
 - .3 Reviewed Shop Drawings, Product data and samples.
 - .4 Field test reports and records.
 - .5 Construction progress schedule.
 - .6 Construction daily log.
 - .7 Meeting minutes
 - .8 Manufacturer's certifications.
 - .9 Current as-built drawings.
 - .10 Safety Data Sheets (SDS) for controlled Products.
 - .11 Manufacturer's installation and maintenance guidelines.
 - .12 Consultant's field review reports and deficiency reports.
 - .13 Permits and reports issued by authorities having jurisdiction.
- .2 Make documents available to Consultant for review at Place of the Work.

1.7 CONTRACTOR USE OF THE PREMISES

- .1 Contractor has unrestricted use of Place of the Work from time of Contract award until Ready-for-Takeover.
- .2 Confine Construction Equipment, Temporary Work, storage of Products, waste materials and debris, and other construction operations to limits required by laws, ordinances, permits, and Contract Documents, whichever is most restrictive. Do not unreasonably encumber Place of the Work.

1.8 OWNER-SUPPLIED PRODUCTS

- .1 Owner Responsibilities
 - .1 Order and pay for Owner-supplied Products not already in Owner's possession.
 - .2 Arrange and pay for delivery of Owner-supplied Products F.O.B. Place of the Work, within time frames required by Contractor's construction progress schedule. If delivered sooner than required by Contractor's latest construction progress schedule submitted to Owner, arrange and pay for delivery to a temporary storage location and subsequent delivery to Place of the Work.
 - .3 Advise Contractor in writing of the value of Owner-supplied Products for Contractor's insurance purposes.

-
- .4 Arrange and pay for delivery to Contractor of reviewed Shop Drawings, Product data, samples, and manufacturer's instructions and certificates.
 - .5 Inspect deliveries jointly with Contractor.
 - .6 Submit claims for transportation damage.
 - .7 Arrange for replacement of damaged, defective or missing items identified at time of delivery.
 - .8 Arrange for manufacturer's field services.
 - .9 Arrange for delivery of manufacturer's warranties to Contractor for inclusion in operation and maintenance manuals.
- .2 Contractor Responsibilities
- .1 Designate in construction progress schedule, time frames for delivery of Owner-supplied Products to Place of the Work and for receipt of related submittals. If place of work is not ready to receive delivery of Owner-supplied Products within the time frame indicated in the latest construction progress schedule submitted to Owner, arrange and pay for delivery to a temporary storage location and subsequent delivery to Place of the Work.
 - .2 Review required submittals and notify Consultant of any observed discrepancies or anticipated problems.
 - .3 Ensure course of construction insurance is adequate to cover Owner-supplied Products.
 - .4 Receive and unload Owner-supplied Products at Place of the Work.
 - .5 Inspect deliveries jointly with Owner. Record and notify Owner and Consultant of shortages and visibly damaged or defective items.
 - .6 Handle Owner-supplied Products at Place of the Work, including uncrating and storage. Dispose of waste materials and debris.
 - .7 Take appropriate precautions to protect Owner-supplied Products from loss or damage.
 - .8 Repair or replace items damaged at Place of the Work.
 - .9 Assemble, install, connect, adjust and finish Owner-supplied Products.
 - .10 Arrange for inspections required by authorities having jurisdiction.
 - .11 Arrange for or perform testing required by authorities having jurisdiction.
 - .12 Workmanship warranty for installation.
 - .13 Make Good Owner-supplied Products damaged by Contractor or Subcontractors at Place of the Work.
- .3 Schedule of Owner-supplied Products
- .1 Towel dispensers.
 - .2 Toilet tissue dispensers.
 - .3 Soap dispensers.

End of Section

1. Definitions

1. The following Section of this Specification are of the abbreviated type and include incomplete sentences. Definite and indefinite articles have often been omitted and sentences are written in the form of direct instructions to the Contractor without using the phrase 'the Contractor shall.' Standard specifications and other quality references inserted govern materials and workmanship without using phrases 'conform with,' 'conformity therewith,' etc. Omitted words and phrases to be supplied in the same manner as they are when a note appears on the Drawings.
2. The Specifications are separated into Sections for reference convenience only. Such separation must in no instance make Owner or his Consultants arbiter to establish subcontract limits between Contractor and Subcontractor.
3. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on Drawings and/or in Specifications, including all labour, materials, equipment, tools, services, and incidentals necessary and required to complete the work. Responsibility for breakdown into and extension of subcontracts, including co-ordination of same, rests entirely with the Contractor.
4. Standard Specifications referred to are editions in force at Tender Closing Date.

2. Terminology

1. Consultants are the team of Architects, Engineers and other experts commissioned by the Owner, directly or indirectly, to execute design, contract documents and supervision for the project, including any of their agents or employees.
2. Prime Consultant is the Architect.
3. Contractor is the Firm or Corporation who, having signed the Agreement, has the sole legal responsibility to carry out the work shown or described in the Contract Documents for the Owner, whether contractually assigned to a Subcontractor or supplier, or not.

3. Minimum Standards

1. Unless otherwise specified, work and material to conform or exceed the minimum standards set out in the editions of the Canadian Government Specification Board, Canadian Standards Associations, the Ontario Building Code, Underwriters' Laboratories of Canada, the Canadian Electrical Code, the Local Building Code in force, whichever is applicable.
2. Copies of Standard Specifications referred to in this Specification to be kept on the site.
3. The use of the name (or its abbreviation) of any of the following bodies, accompanied by the reference number of a specification of that body to mean that the entire specification of the body to apply as noted:

AISC: American Institute of Steel Construction;
ASTM: American Society for Testing Materials;
CEC: Canadian Electric Code;
CGSB: Canadian Government Specification Board;
CISC: Canadian Institute of Steel Construction;
CRCA: Canadian Roofing Contractors' Association;
CSA: Canadian Standards Association;
OBC: Ontario Building Code;
ULC: Underwriters' Laboratories of Canada;
CLA: Canadian Lumbermen's Association;
OIRCA: Certification for Roofing Contractors.

4. Cooperation

1. Each trade to co-operate with the trades of adjacent or affected work. Supply in good time requirements effecting adjacent and underlying work in writing and items to be set or built in. Similarly, heed requirements and build-in items provided by other trades.
2. Take necessary precautions to protect work of other trades from contamination, marring or other damage due to application or installation processes, methods and activities.
3. General Contractor and each trade to co-operate with Contractors which may be assigned or selected by the Owner to perform work under Cash Allowances. Owner reserves the right to assign non-unionized labour to perform work under Cash Allowances, at Owners discretion.

5. Coordination

1. Co-ordinate the work of all trades in such a manner that each trade co-operates with the trade of adjacent work.
2. Organize minimum bi-weekly job site meetings and send out notices stating time and place to Consultants, subcontractors, Suppliers and all others whose presence is required at the meetings. Owner reserves the right to increase frequency of meetings at their discretion or when construction progress schedule is not being met.
3. Take note of all persons attending these meetings and submit to the entire project team, Minutes of these Meetings showing any major decisions made and instructions or information required.
4. Co-ordinate the Work in this Contract with the work of others awarded work under Cash Allowances.

6. Building Dimensions and Co-ordination

1. Ensure that all necessary job dimensions are taken and all trades are coordinated for the proper execution of the work. Assume complete responsibility for the accuracy and completeness of such dimensions, and for co-ordination.

2. Verify that all work, as it proceeds, is executed in accordance with dimensions and positions indicated which maintain levels and clearances to adjacent work, as set out by requirements of the drawings, and ensure that work installed in error is rectified before construction resumes.
3. Check and verify all dimensions referring to the work and the interfacing of all services. Verify all dimensions, with the trade concerned when pertaining to the work of other trades. Be responsible to see that Subcontractors for various trades co-operate for the proper performance of the Work.
4. Avoid scaling directly from the drawings. If there is ambiguity or lack of information, immediately inform the Consultant. Be responsible for any change through the disregarding of this clause.
5. All details and measurements of any work which is to fit or to conform with work installed shall be taken at the building.
6. Advise Consultant of discrepancies and if there are omissions on drawings, particularly reflected ceiling plans and jointing patterns for paving, ceramic tile, or carpet tile layouts, which affect aesthetics, or which interfere with services, equipment or surfaces. **DO NOT PROCEED** without direction from the Consultant.
7. Ensure that each Subcontractor communicates requirements for site conditions and surfaces necessary for the execution of the Subcontractor's work, and that he provides setting drawings, templates and all other information necessary for the location and installation of material, holes, sleeves, insets, anchors, accessories, fastenings, connections and access panels. Inform other Subcontractors whose work is affected by these requirements and preparatory work.
8. Prepare interference drawings to properly co-ordinate the work where necessitated. Refer to Section 01340.

7. Use of Premises Before Substantial Performance

1. The Owner shall have the right to enter and occupy the building, in whole or in part, for the purpose of placing fittings and equipment, or for other use, before completion of the Contract if, in the opinion of the Consultant, such entry and occupancy does not prevent or interfere with the Contractor in the performance of the Contract. Such entry shall in no way be considered as an acceptance of the Work in whole, or in part, nor shall it imply acknowledgment that terms of the Agreement are fulfilled.

8. Layout of Work

1. Layout work with respect to the work of all trades. Arrange mechanical and electrical work such as piping, ducts, conduits, panels, equipment and the like to suit the architectural and structural details.
2. Alterations necessary due to conflict and interference between trades, to be executed at no cost to the Owner unless notification is given in writing before Tender Closing Date.

9. By-Laws and Regulations

1. Nothing contained in the Drawings and Specifications are to be so construed as to be knowingly in conflict with any law, by-law or regulation of municipal, provincial or other authorities having jurisdiction.
2. Perform work in conformity with such laws, by-laws and regulations and make any necessary changes or deviations from the Drawings and Specifications subsequently required as directed and at no cost to the Owner unless notification is given in writing before Tender Closing Date.
3. Furnish inspection certificates and/or permits as may be applicable as evidence, that installed work conforms with laws, by-laws, and regulations of authorities having jurisdiction.

10. Protection

1. Take necessary precautions and provide and install required coverings to protect material, work and finishes from contamination, damage, the elements, water and frost.
2. Make good any damage or replace damaged materials, as directed. Repairs to be made by the trade having originally installed or fabricated the damaged material, finish or item. Protect electrical equipment from water and the elements.
3. Protect adjacent private and public property from damage and contamination.
4. Protect curbs and sidewalks from damage from trucking by means of boards and the like. Repair, or pay or repair of damage to existing roads and sidewalks.
5. Mark glass after glazing in an acceptable manner, and leave in place until final clean-up.
6. Protect floor finishes from construction traffic and transport of construction materials and equipment by means of 6 mm plywood panels.

11. Delivery, Handling and Storage of Materials

1. Schedule material delivery so as to keep storage at site to the absolute minimum, but without causing delays due to late delivery.
2. Store materials which will be damaged by weather in suitable dry accommodation. Provide heat, as required, to maintain temperatures recommended by material manufacturer.
3. Store highly combustible or volatile materials separately from other materials, and under no circumstances, within the building. Protect against open flame and other fire hazards. Limit volume of supply on the site to minimum required for one day's operations.

4. Handle and store material so as to prevent damage to material, structure and finishes. Avoid undue loading stresses in materials or overloading of floors.
5. Do not store material and equipment detrimental to finished surfaces within areas of the building where finishing has commenced or has been completed. All material storage within the building is subject to relocation, as directed.
6. Deliver package material in original, and Storage of unopened and undamaged containers with manufacturer's labels and seals intact.

12. Debris

1. Assign clean-up duties to a crew with own Foremen which will be of sufficient size to prevent accumulation of debris and dirt in any part of the structure or on the site.
2. Remove construction debris on a daily basis and legally dispose of same.
3. Under no circumstances, should debris, rubbish or trash be burned or buried on the site.

13. Cutting, Fitting and Patching

1. Required cutting to be done by General Contractor. Patching and painting of work to be executed by the General Contractor.
2. All sub-trades are to notify the General Contractors bidding as to the extent of the cutting, patching, and painting of their respective trades.
3. Drilling, cutting, fitting and patching necessary due to failure to deliver items to be built-in time, or installation in wrong location to be executed, as directed, at no cost to the Owner.
4. Give written notification prior to commencement of drilling and cutting of load bearing structural members and finished surfaces.
5. Cut holes with smooth, true, clean edges, after they are approved by applicable trade. Size holes and openings for hot water and steam pipes, so as to allow for expansion and contraction of such pipes.

14. Fastenings

1. Supply all fastenings, anchors and accessories required for fabrication and erection or work.
2. Metal fastenings to be of the same material as the metal component they are anchoring, or of a metal which will not set up an electrolysis action which would cause damage to the fastening or metal component under moist conditions.
3. Exposed metal fastenings and accessories to be of the same texture, color, and finish as base metal on which they occur. Keep to a minimum; evenly space and lay out.

4. Fastenings to be permanent, of such a type and size and installed in such a manner to provide positive anchorage of the unit to be secured. Wood plugs are not acceptable. Install anchors at required spacing to provide required load bearing or shear capacity.
5. Power actuated fastenings not to be used without prior written approval for specific use.

15. Surplus Materials

1. Surplus materials specifically so specified, to remain property of the Owner and be neatly stockpiled or stored, as directed.
2. All other surplus materials to become property of the Contractor; to be removed from the site and legally disposed of.

16. Setting of Work

1. Provide and pay for the services of a Land Surveyor, registered in the Province of Ontario to establish the building location and two (2) widely separated bench marks at the commencement of the work.
2. Lay out building lines for the work and provide substantial stakes, batterboards or monuments to preserve lines and levels.
3. Provide to the Consultant a survey plan on CAD indicating location of perimeter foundation walls relative to property lines and their top elevation, before construction proceeds on the foundation walls.
4. Verify on the site all grades, lines, levels, dimensions and location of hydrants, existing structures, manholes, overhead and buried utilities, existing trees, roadways, sidewalks and the like, shown on the drawings, and report omissions, errors, or inconsistencies, before commencing work.
5. Upon completion of layout work and before commencement of any excavation, give ample notification to allow for inspection of lines and levels. Such inspection does not in any way mitigate the Contractor's responsibility for accuracy of layout.
6. Preserve and protect bench marks, elevation datum and monuments and check periodically for accuracy until all work is complete. Remove same and their protection, as directed, and make good site.

17. Documents Required and General Duties

1. **At Commencement of Contract**
 - .1 Supply Performance Bond and Labour and Material Bond within ten (10) days of acceptance of the Tender.
 - .2 Supply Public Liability and Property Damage Insurance Certificates.
 - .3 Supply Certificates of good standing from Workers' Compensation Board for the General Contractor and all Subcontractors.
 - .4 Supply Contract Sum Breakdown of all sub-trades or parts of work and general

- expense items.
- .5 Supply Construction Schedule.
- .6 Supply Schedule of Shop Drawing Submissions.
- .7 The Owner has paid for the cost of the Building Permit. Mechanical Subcontractor will pay the cost of other Fees related to the Work Specified under Mechanical Scope. Electrical Subcontractor will pay the cost of all permits and fees related to the Work specified under Electrical Scope.
- .8 The General Contractor is to pay all other fees and refundable deposits if applicable.

2. During Construction

- .1 Adjust Allowances, as required.
- .2 Organize Job Meetings in accordance with Section 01200.
- .3 Supply Monthly Progress Reports and Construction Schedule in accordance with Section 01200.
- .4 Confirm that payments are being made to subcontractors and suppliers by submission of receipts with the second and subsequent Progress Payment Application. No payment will be made for unincorporated material on the site, unless Bill of Sale in proper format is provided.

3. Upon Completion

- 1. Upon completion of work before the Final Certificate of Payment is issued, the following to be observed, executed and submitted:
 - .1 All deficiencies to have been completed in a satisfactory manner.
 - .2 All final clean-up to have been executed, as specified in Section 01710.
 - .3 Finishing Hardware, Inspection and Verification.
 - .4 Organize a Final Inspection tour at which to be present:
 - the Owner's authorized representative;
 - the Architectural, Structural, Mechanical and Electrical Consultants, and their supervisory personnel, if any;
 - the Contractor and his superintendent.
 - .5 Where the above procedure is impossible or where any deficiencies remain outstanding, the Owner's representative and the Consultant concerned, to inspect and accept the affected work and/or material upon notification by the Contractor, that all deficiencies involving this Consultant have been made good.
 - .6 General Contractor to organize and attend Owner's user training site walkthrough following project completion.
 - .7 General Contractor to attend an 11 month warranty walkthrough meeting with the Owner as required by Owner.
 - .8 General Contractor to work with the Owner's assigned Commissioning Agent to adjust all newly installed building systems accordingly.
 - .9 GC to provide all start up reports with closeout requirements (noted in mech spec)
 - .10 A complete release of all liens arising out of this Contract, other than his own. If a subcontractor or supplier refuses to furnish a release of such a lien, furnish a bond satisfactory to the Owner to indemnify him against any claim under such a lien.
 - .11 Certificates of good standing from the Workers' Compensation board, for the General Contractor and all Subcontractors.
 - .12 All reference records, as specified, under Section 01720.

- .13 Certificate of Inspection from Mechanical and Electrical Engineers.
- .14 Copies of all Lists of Deficiencies with each Deficiency verified when complete by only this project's job Superintendent. The Final List of Deficiencies to be signed, completed by all concerned, if accepted.
- .15 Statement of Completion from General Contractor.
- .16 Final adjustment of all Allowances.
- .17 H.E.P.C. Inspection Certificate and all other Inspection Certificates required by Provincial, Municipal and other authorities having jurisdiction.
- .18 Balancing Reports.
- .19 As-Built Drawings. – Hardcopy mark ups and digital AutoCAD v2020 or higher.
- .20 Two hard copies of Operation and Maintenance Manuals. A digital copy (pdf file) of all closeout documents to be provided on both a link and USB memory stick format. Refer to sections 01720 and 01730.
- .21 The General Contractor will onboard the services of Inspection and Testing Companies in collaboration with the Owner as described in the Cash Allowance for the General Contractor to coordinate.

18. Progress Reports

1. Submit to the Architect, Monthly Progress Reports consisting of a concise narrative and a marked-up summary schedule showing physical percentage complete by item and in total. These progress calculations must agree with the Progress Payment Claims.
2. Keep permanent written daily records on the site on the progress of work. Record to be open to inspection at reasonable times and copies to be furnished upon request. Records to show notes of commencement and completion of different trades and parts of work; daily high and low temperatures and other weather particulars; number of men engaged on the site (including sub-trades) broken down in groups for each type of construction work, and particulars about excavation and shoring; erection and removal of form work; pouring and curing of concrete; floor finishing; placing and compaction of backfill, masonry work; roofing.
3. Daily progress to give particulars on commencement and completion of each trade or part of work; form work erections and removal; concrete pouring and curing; floor finishing; masonry work; roofing; waterproofing; finishing trades, tests and inspection and the like.

19. Inspection and Testing

1. The General Contractor will onboard the services of Inspection and Testing Companies in collaboration with the Owner as described in Cash Allowances for the GC to coordinate. The cost of inspection and testing will be deducted from the Inspection and Testing Allowance specified under Section 01020, "Allowances".
2. Where tests or inspections reveal work not in accordance with Contract requirements, the Contractor shall pay costs for additional tests or inspections as the Architect may require to verify acceptability of corrected work.
3. The Inspection and Testing by the Owner's Testing Company does not relieve the Contractor of his responsibility to provide his own quality control in order to meet or exceed the requirements of specified standards, codes, design criteria and referenced documents.

20. General Notes

1. The Contractor shall visit the property and make themselves fully aware of all existing construction so that they may include for all contingencies.
2. Contractor to familiarize themselves with existing conditions and notify the consultant of any inconsistencies prior to ordering or installation of materials.
3. All dimensions must be confirmed on site by contractors. Carefully examine all existing site conditions and building components along with all dimensions that will affect the proper execution of work in order to obtain a clear and comprehensive understanding of the work required to complete the project.
4. All work is to be executed by experienced tradespersons to the best workmanship, in conformance to requirements of the Ontario Building Code, local/ municipal by-laws, regulations and to ordinances of authorities having jurisdiction, all to the satisfaction and approval of the owner and consultant.
5. Except as indicated, dimensions shown on plans are:
 - A. On new Partitions – Face of studs
 - B. On existing Partitions – From face of existing finish

21. Designated Substance Report

General contractor is responsible to review designated substance report included in specification book and take actions (if required) in areas within scope of work. Report immediately to architect and client before proceeding with any abatement work.

22. Work Restrictions

Should the Contractor not be able to finish the scope of work by the Substantial Completion date, the Contractor shall complete all invasive work, at their own cost, after hours and on the weekend during times when the school is closed. The Contractor shall make arrangements with the Owner for all after-hours work. All occupied spaces scope of work shall be completed by **August 2, 2027**. The non-noisy work in areas other than occupied spaces can be completed during school hours and shall be coordinated with the owner. All exit doors and corridors shall not be blocked at any time.

End of Section

1.1 Selection of Products

1. If requested by the Consultant, provide the following services and/or information:
 - .1 Assist the Consultant in determining qualified suppliers.
 - .2 Obtain proposals from suppliers.
 - .3 Make appropriate recommendations for consideration of Consultant.
 - .4 Notify Consultant of any effect anticipated by selection of product or supplier under consideration, on construction schedule and contract sum.
2. On notification of selection, enter into purchase agreement with designated supplier.

1.2 Cash Allowance

1. Expend cash allowance **only** on the Consultant's written instructions and with an Owner approved Cash Allowance Expenditure (CAE) form.
2. Include in Contract price the Contractor's charges for handling at site, including uncrating and storage, protection from elements and damage, labour, installation and finishing, testing, adjusting and balancing, and other expenses including overhead and profit on account of Cash Allowance in accordance with Article GC4.1 of the General Conditions of the Contract as amended.
3. Credit the Owner with any unused portion of Cash Allowances in the statement for final payment.
4. If a test made under payment by a specific allowance proves that the material or system is not in accordance with the Documents, then the subsequent testing including Owner's testing of replacement materials or systems shall be Contractor's expense and not taken from Cash Allowance.
5. Add or deduct any variation in cost from the Cash Allowance. No adjustment will be made to Contractor's expense.
6. The amount of each allowance includes the net cost of the product or service, delivery and unloading at the site.
7. All refunds, trade and/or quantity discounts which the Contractor may receive in the purchase of goods under allowances, to be extended to the Owner.
8. Receipted invoices covering all disbursements made by the Contractor under Allowances, to be submitted to the Consultant for audit.
9. Where the Cash Allowance stipulates "Supply Only," the Contract Price and not the Cash Allowances include the installation and hook-up costs. The installation and hook-up of some equipment and materials are specified under other Sections of the Specifications. The General Contract includes the installation and hook-up not specified elsewhere.

10. Contractor's profit and overhead on all Cash Allowances to be carried in his lump sum amount, not in the Cash Allowances.
11. All Cash Allowances will be dealt with in accordance with Article GC4.1 of the General Conditions.
12. All expenditures under Cash Allowances must be approved by the Owner.
13. Include in the Stipulated Price quoted, a Cash Allowance in the amount of **\$500,000 +HST Five Hundred Thousand Dollars.**

To be allocated as follows:

Inspection and Testing

- Testing of topsoil
- Testing of soil to be removed from site.
- Testing of compacted fill
- Other soils compaction testing
- Concrete testing
- Structural steel inspection/testing
- Mortar testing
- Asphalt testing
- Building envelope – air barrier, curtain wall, windows, etc.
- Waterproofing
- Sprayed fireproofing
- Civil inspections and testing as per Municipal requirements

Gas Service Connection

- Local utility charges related to increased gas service if required & new meter, if required

Finish Door Hardware (supply only)

- Door hardware (excluding cabinet hardware which is included in Section 06400)
- Lockset at tall cabinets to be included in this cash allowance is for hardware supply only.
- Includes exterior and interior hardware
- Installation of all hardware is included in the Contract.

Interior and Exterior Signage (supply and install)

- Major and minor signage
- Door signage
- Vision Strips
- Exterior Pylon Sign
- Update logo to exterior building sign only to capture new WCDSB branding/colours.

Network/ Communication

- Supply and installation of voice/ data network
- Testing, certification, and documentation of voice/ data systems.
- Testing and communication of PA system

System Security

- Keypad
- System Control
- Motion detectors
- Sirens
- Low temp sensors
- Lighting control connection if applicable
- ULC fire monitoring control panel
- Card access
- Etc.

Building Automation

- Additional controllers, sensors, actuators – graphics updates and system integration

Window Coverings

Asbestos Abatement

Poor Soil Conditions

Terrazzo repairs

Lighting Controls (supply only)

- Installation of all lighting controls is included in the base Contract

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

15. Taxes HST not to be included in Cash Allowance amounts and will be carried separate from the General Contractor's Stipulated Sum Amount.

16. Refer to Section 01005 for co-operation with others assigned to this Section.

End of Section

1. Project Meetings for Coordination

1. In consultation with the Consultant during the second week of construction, arrange for site meetings weekly or every 2 weeks as appropriate to the stage of construction, for project coordination. Such meetings shall fall at the same time each week the meeting is scheduled.
2. Responsible representatives of the Contractor's and Subcontractor's office and field forces and suppliers shall be obliged to attend.
3. Inform the Owner, Consultant, and those others whose attendance is obligatory, of the date of each meeting, in sufficient time to ensure their attendance.
4. Provide physical space for meetings, prepare an agenda, chair and record the minutes of each meeting. Relevant information must be made available to all concerned, in order that problems to be discussed may be expeditiously resolved. Identify "action by: _____".
5. Within four days after each meeting, distribute digital copies of the minutes to each invited person.
6. **It should be understood that the project design team will not work with the General Contractors Construction Administration software during the duration of the project.**

2. Pre-construction Meeting

1. Within 5 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
2. Include in the agenda the following:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Scheduling of Work. Schedule to include a detailed breakdown of mechanical and electrical works.
 - .3 Interference with ongoing business: School operations, bell times, portable deliveries/removals by others, etc.
 - .4 Work by other Contractors.
 - .5 Schedule of submission of shop drawings and samples.
 - .6 Site Logistics- Requirements for temporary facilities, site sign, offices, storage sheds, utilities. Delivery schedule of specified equipment. Site Security. Site Access, contractor parking, temporary fencing and housekeeping.
 - .7 Status of Building Permit and Inspections.
 - .8 Communications (requirements for temporary power and water shutdowns, chain of communications, scheduling access to occupied areas, etc.)
 - .9 Contemplated change notices, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

- .10 Record drawings.
- .11 Maintenance manuals.
- .12 Take-over procedures, acceptance, warranties.
- .13 Monthly progress claims, administrative procedures, photographs, holdbacks.
- .14 Appointments of inspection and testing agencies or firms.
- .15 Insurance, transcript of policies.
- .16 Schedule for progress meetings.

3. Project Meetings for Progress of Work

1. Conduct progress meetings in accordance with the schedule and/or decisions made at Pre-construction meeting.
2. Inform the Owner, Consultant, project consultants, Subcontractors and suppliers and those whose attendance is obligatory, of the date of the meeting, in sufficient time to ensure their attendance.
3. Include in the agenda the 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 Revisions to construction schedule.
 - .8 Progress during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Pending changes and substitutions.
 - .12 Review status of RFIs, Site Instructions, Change Orders/ Proposed Change Orders, etc.
 - .13 Review proposed changes for effect on construction schedule and on completion date.
 - .14 Other business.

4. Progress Records

1. Maintain a permanent written record on the site of the progress of the work using standard OGCA form. This record shall be available to the Consultant at the site, and a copy shall be furnished to same on request. The record shall contain:
 - .1 Daily weather conditions, including maximum and minimum temperatures.
 - .2 Dates of the commencement and completion of stage or portion of the work of each trade in each area of the project.
 - .3 Conditions encountered during excavation.
 - .4 Dates of erection and removal of formwork, in each area of the project.

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- .5 Dates of pouring the concrete in each area of the project, with quantity and particulars of the concrete.
 - .6 Work force on project daily per trade.
 - .7 Visits to site by personnel of Consultant, Jurisdictional Authorities and testing companies.

End of Section

1.1 CONSTRUCTION PROGRESS SCHEDULE

- .1 Format and Content:
 - .1 Prepare schedule in the form of a critical path method (CPM) Gantt chart using appropriate scheduling software.
 - .2 Incorporate a work breakdown structure identifying key activities, work packages, and major milestones, including long delivery Products, inspection and testing activities, preparation and review of mock-ups, Owner decisions for cash allowances, shutdown or closure activities, delivery of Owner-supplied Products, Owner performed work, demonstration and training activities, and similar items, at a sufficient level of detail to effectively manage construction progress.
 - .3 Indicate milestone dates for Ready-for-Takeover and Substantial Performance of the Work.
- .2 Submission:
 - .1 Submit initial schedule to Owner and Consultant within 10 Working Days after Contract award.
 - .2 Submit schedule as portable document format (.pdf) files.
 - .3 Consultant will review format and content of initial schedule and request necessary changes, if any, within 5 Working Days after receipt.
 - .4 If changes are required, resubmit finalized initial schedule with 5 Working Days after return of reviewed copy.
 - .5 Submit updated progress schedule monthly to Owner and Consultant, indicating actual and projected start and finish dates with report date line and progress, activity relationships, critical path, float, and baseline comparison to current progress.
 - .6 Indicate a written report with each updated progress schedule. Indicate work status to date comparing baseline to actual progress, current forecasts, identifying problem areas, anticipated delays and impact on schedule, and planned corrective actions.

1.2 SUBMITTALS SCHEDULE

- .1 Format and Content:
 - .1 Prepare schedule identifying required Shop Drawings, Product data and sample submissions, including samples required for testing and including those for Owner-supplied Products.
 - .2 Prepare schedule in electronic format.
 - .3 Incorporate separate line items for each required submittal, organized by Specification sections numbers and titles, and further broken down by individual Products and systems required.
 - .4 For each required submittal, show planned earliest date for initial submission, earliest date for return of reviewed submittal by Consultant, and latest date for return of reviewed submittal without causing delay.
 - .5 Allow time in schedule for resubmission of submittals, should resubmission be necessary.
- .2 Submission:
 - .1 Submit initial schedule to Owner and Consultant within 15 Working Days after Contract award.

- .2 Submit schedule as portable document format (.pdf) files.
- .3 Consultant will review format and content of initial schedule and request necessary changes, if any, within 5 Working Days after receipt.
- .4 If changes are required, resubmit finalized initial schedule within 5 Working Days after return of reviewed copy.
- .5 Submit updated submittals schedule monthly to Owner and Consultant.

1.3 SCHEDULE MANAGEMENT

- .1 A schedule submitted as specified and accepted by Consultant will become the baseline schedule and shall be used as the baseline for updates.
- .2 At regular progress meeting, review and discuss current construction progress and submittals schedules with Consultant and Owner, including activities that are behind schedule and planned measures to regain schedule slippage in key areas on or near the critical path.
- .3 Activities considered behind schedule are those with start or completion dates later than the dates shown on the baseline schedule.

1.4 CONSTRUCTION DAILY LOG

- .1 Maintain a construction log, recording on a daily basis the following information:
 - .1 Number of workers actively working at Place of the Work, organized on a Subcontract basis.
 - .2 Subcontractors present at Place of the Work.
 - .3 Identify the parts of the Work being worked on.
 - .4 Identify the working hours being kept at Place of the Work.
 - .5 Activities with intermittent progress.
 - .6 Time lost with an explanation as to cause.
 - .7 Difficulties encountered, such as construction activity delays, labour inefficiencies, labour shortages, etc.
 - .8 Product deliveries.
 - .9 Equipment mobilization and de-mobilization.
 - .10 Demolition conditions.
 - .11 Start and finish dates for each part of the Work.

1.5 RECORDING ACTUAL SITE CONDITIONS ON AS-BUILT DRAWING

- .1 Keep one hard-copy set of Drawings at Place of the Work for the purpose of creating as-built drawings. Record information and maintain as-built drawings in clean, dry and legible condition.
- .2 Clearly label each drawing as "AS-BUILT DRAWING". Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .3 Record actual construction including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.

- .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
- .3 Measured locations of pipes, ducts, conduits, outlets, fixtures, access panels, and appurtenances, referenced to visible and accessible features of construction.
- .4 Field changes of dimension and detail.
- .5 Changes made by Change Orders and Supplemental Instructions.
- .6 References to Shop Drawings, where Shop Drawings show more detail.

1.6 PROGRESS PHOTOGRAPHS

- .1 Arrange for periodic digital photography to document and record the progress of the Work.
- .2 Photographs will be properly exposed and in focus, with unobstructed views.
- .3 Identify each photograph by Project name and date taken.
- .4 Format photographs as .jpg, .bmp or .tif format files in high definition resolution.
- .5 Submit progress photographs monthly as part of current application for payment.
- .6 Submit additional photographs showing special conditions when requested by Consultant.
- .7 Do not use progress photographs, or any other Project photographs for promotional purposes without Owner's written consent.

End of Section

1. General

1. Submit to Architect, for review, shop drawings, product data and samples specified.
2. Until submission is reviewed, work involving relevant product must not proceed.

2. Shop Drawings

1. Drawings to be originals prepared by Contractor, Subcontractor, Supplier or Distributor, which illustrate appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate Sections.
2. Identify details by reference to sheet and detail numbers shown on Contract Drawings.
3. Maximum sheet size 24" x 36" as a PDF.

3. Project Data

1. Certain specification Sections specify that manufacturer's standard schematic drawings, catalogue sheets, diagrams schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings.
2. Above will only be accepted if they conform to following:
 - .1 Delete information which is not applicable to project.
 - .2 Supplement standard information to provide additional information applicable to project.
 - .3 Show dimensions and clearances required.
 - .4 Show performance characteristics and capacities.
 - .5 Show wiring diagrams (when requested) and controls.

4. Coordination of Submissions

1. Review shop drawings, product data and samples prior to submission.
2. Verify:
 - .1 Field measurements.
 - .2 Field construction criteria.
 - .3 Catalogue numbers and similar data.
3. Coordinate each submission with requirement of work and Contract documents. Individual shop drawings will not be reviewed until all related drawings are available.
4. Contractor's responsibility for errors and omissions in submission is not relieved by Architect's review of submittals.
5. Contractor's responsibility for deviations in submission from requirements of Contract documents is not relieved by Architect's review of submission, unless Architect gives written acceptance of specified deviations.

6. Notify Architect, in writing at time of submission, of deviations from requirements of Contract documents.
7. After Architect's review, distribute copies.

5. Submission Requirements

1. Schedule submissions at least ten (10) days before dates that reviewed submissions will be required to be returned.
2. Submit a digital copy (PDF) of shop drawings, product data to Architect for review.
3. Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Number of each shop drawing, product data and sample submitted.
 - .5 Other pertinent data.
4. Submissions must include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name of:
 - .1 Contractor.
 - .2 Subcontractor.
 - .3 Supplier.
 - .4 Manufacturer.
 - .5 Separate detailer when pertinent.
5. Identification of product or material.
 - .1 Relation to adjacent structure or materials.
 - .2 Field dimensions, clearly identified as such.
 - .3 Specification Section number.
 - .4 Applicable standards, such as CSA or CGSB numbers.
 - .5 Contractor's stamp, initialled or signed, certifying review of submission, verification of field measurements and compliance with Contract documents.
6. Interference Drawings
 - .1 Prepare interference drawings for all work in confined space ie: ceiling space.

End of Section

1. Access

1. Provide and maintain adequate service roads to project site to provide safe and convenient access for deliveries.

2. Contractor's Site Office

1. Contractor's trailer will be used as site office during construction and to accommodate site meetings. It shall be furnished with drawing layout table, telephone, and facsimile machine for the duration of the project. Facsimile is to be installed on dedicated line and not connected to telephone line. Pay telephone not acceptable.
2. Maintain in clean condition.
3. Provide and maintain in clean condition: two separate plans layout tables, minimum 48" x 72" each. One table shall be used by the General Contractor, and Subcontractors, at their discretion. The second shall be provided for use by subcontractors and by the consultant or Inspection and Testing Companies during site visits or project meetings.

3. Storage Sheds

1. Provide adequate weather-tight sheds with raised floors, for storage of materials, tools and equipment which are subject to damage by weather.

4. Sanitary Facilities

1. Existing sanitary facilities cannot be used during construction. Keep area and premises in sanitary condition.

5. Parking

1. Contractor parking will be located separately from existing school parking. Spaces will be designated by owner.

6. Site Enclosures

1. Erect temporary site enclosures, hoarding, using prefabricated lock fence system.
2. Size and location of enclosure to suit area of construction.

7. Enclosure of Structure

1. Provide temporary weather-tight enclosures protection for exterior openings until permanently enclosed.
2. Erect enclosures to allow access for installation of materials and working inside enclosure.
3. Design enclosures to withstand wind pressure.

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4. Erect dust barriers to prevent dust migration to non-renovated areas.

8. Power supply

1. General Contractor will have a shared responsibility for power consumption costs during construction. Utilities and temporary heating, and power to be reimbursed to the board during project. Board to monitor consumption pre-post and provide utility bills as backup.

9. Water Supply

1. General Contractor will have a shared responsibility for water consumption costs during construction. Board to monitor consumption pre-post and provide water bills as backup

10. Scaffolding

1. Construct and maintain scaffolding in rigid, secure and safe manner.
2. Erect scaffolding independent of walls. Remove promptly when no longer required.
3. Scaffolding to be designed by a professional Engineer when required under the Occupational Health and Safety act.

11. Heat and Ventilating

1. Not applicable.

End of Section

1. Construction Safety Measures

1. Observe and enforce construction safety measures required by the National Building Code; the O.B.C.; The Provincial Government; Workers' Compensation Board; and Municipal authorities.
2. In particular, the Occupational Health and Safety Act (Ont. Re. 213/91), the Occupational Health and Safety Act, the regulations of the Ontario Ministry of Labour and Ontario Hydro Safety requirements shall be strictly enforced.
3. Contractor shall ensure that copies of all applicable construction safety regulations, codes and standards are available on the job-site throughout the period of construction. All workers are to be informed that these documents are available for reference at any time.
4. The Contractor shall ensure that all supervisory personnel on the job-site are fully aware of the contents of the Occupational Health and safety Act (Ontario Regulation 213/91 - Construction Projects) the Workers' Compensation Act" and, Bill 208 (Chapter 7, Standards of Ontario) "An Act to Amend the Occupational Health & Safety Act and the Workers' Compensation Act", and, that they comply with all requirements and procedures prescribed therein. These documents include, but are not limited to, the following construction safety requirements:
 - .1 Contractor to register with the Director of the Occupational Health and Safety Division before or within 30 days of the commencement of the project, (O.Reg. 213/91, sec 5).
 - .2 File a notice of project with a Director before beginning work on the project, (O.Reg. 313/91, sec 6).
 - .3 Notification prior to trenching deeper than 1.2m, (O.Reg. 213/91, sec 7).
 - .4 Accident Notices and Reports, (O.Reg. 213/91, sec 8 through sec 12).
 - .5 General Safety Requirements, (O.Reg. 213/91, sec 13 through sec 19).
 - .6 General Construction Requirements, e.g. protective clothing, hygiene practices, housekeeping, temporary heat, fire safety, access to the job site, machine and equipment guarding and coverings, scaffolds and platforms, electrical hazards, roofing, et al, (O.Reg. 213/91, sec 20 through sec 221).
 - .7 Establish a Joint Health and Safety Committee where more than 19 workers are employed for more than 3 months, (Bill 208, S.8(2) to S.8(14).
 - .8 Establish a Worker Trades Committee for all projects employing more than 49 workers for more than 3 months, (Bill 208, S-8a(1) to S.8b(4).
 - .9 Ensure that all activities arising out of (.07) and (.08) above are recorded and that minutes are available to an inspector of the Ontario Ministry of Labour.
5. The Contractor shall be considered as the "Constructor" in consideration of the rights and responsibilities for all construction safety requirements, procedures, facilities and inspection of all work performed by the Contractor, Subcontractors/Sub-trades and other Contractors engaged on this project.
6. In the event of a conflict between any of the provisions of the above authorities the most stringent provisions are to be applied.

2. Material Safety Data Sheet

1. Material safety Data Sheets (MSDS) must be available at the job site for any product listed on the Hazardous Ingredients List prior to being used, installed or applied inside of the building.
2. A Material Safety Data Sheet is to be submitted to the Architect for any product which is known to create, or suspected of creating, a health hazard or discomfort during construction or upon commissioning of the project including, but not limited to, the following:
 - .1 adhesives
 - .2 solvents
 - .3 sealants, (caulking, vapour seals, etc.)
 - .4 sprayed-on fireproofing
 - .5 resilient flooring
 - .6 carpet, paint, varnish or other coatings
 - .7 exposed membrane waterproofing
 - .8 special coatings, (terrazo sealants, chafing coatings, etc.)
 - .9 solder, brazing and welding and other filler metal
 - .10 other products whose particles or vapours may become air borne after installation.
 - .11 any other product as directed by the Consultant.
3. Comply with WHMIS regulation, Workplace Hazardous Material Information System.

3. Fire Safety Requirements

1. Comply with requirements for Building Construction, the Ontario Building Code, the Ontario Fire Code, the requirements of Local Fire Authorities and of the requirements of the Office of the Fire Marshal.

4. Overloading

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

5. Falsework

1. Design and construct falsework in accordance with CSA S269.1-1975.

6. Scaffolding

1. Design and construct scaffolding in accordance with CSA S269.2-M1980.
2. Scaffolding to be designed by a Professional Engineer when required under the Occupational Health and Safety Act.

7. Materials Specifically Excluded

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1. Asbestos and/or asbestos-containing products are not permitted. Submit Material Safety Data Sheets for any product suspected of containing asbestos if so requested by Consultant. Examples of some materials requiring close scrutiny and/or confirmation include:
 - .1 Transite drainage pipe - whether buried or above grade - not permitted.
 - .2 Composite floor tile containing asbestos - not permitted.
 - .3 Lay-in ceiling tiles containing asbestos - not permitted.
 - .4 Insulation and/or jacketing for pipes, ducts, motors, pumps, etc. - not permitted if any asbestos is present.
 2. Solder for all piping is to be lead-free.
 - .1 "Lead Free" shall mean solder which contains less than 0.030% of lead when dissolved in fluoroboric and nitric acids and tested by inductively coupled argon plasma atomic emission spectroscopy. "Steelbond 281" and "Silverbrite" are acceptable solder products.
 - .2 The mechanical contractor shall provide an affidavit signed by the Principal of the company, on company letterhead, that all of the solder used on the project was either one of the two acceptable products or that the solder used (identified by brand name) meets or exceeds the testing criteria.
 - .3 The Owner shall undertake random testing of the soldered joints. Should testing prove that the solder used was not as specified, the Owner shall take action against the contractor to the full extent of the law.
 3. All paint and finish coatings are to be lead and mercury-free. Submit Material Safety Data Sheets confirming that these products are free of all lead and/or mercury compounds.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. These specifications apply to all 16 divisions of the project specification. It is the responsibility of the contractor to apply these provisions wherever practical within specification limits to all products and services used on this project.
2. It is recognized that currently specified materials and methods may conflict with the basic intention of this section. Where reasonable alternate materials and methods exist that are not specified here, and that do not compromise quality or create additional cost for the owner, notify the Architect of such alternate materials or methods. Do not proceed to use alternate materials or methods to those specified without the express approval of the Architect.
3. Elsewhere, apply the provisions of this section to all work. Exceptions can only be made when signed off by the Architect. Suitability of all products used is the responsibility of the contractor.

1.2 Compliance Specifications

1. The contractor must comply with all applicable health, safety and environmental regulations.

1.3 Beyond Compliance Specifications

1. These specifications apply in addition to all applicable health, safety and environmental compliance regulations. They are incorporated here to reflect the Owner's intention to develop a specification which maximizes environmentally "friendly" materials and methods wherever possible within current technical and budget limitations.
2. Beyond compliance specifications recognize that performance well beyond the minimum regulatory standard is often desirable, possible and affordable, often with no cost or low cost options. It also recognizes that application methods or protocols may be as important as the material specified. Therefore these specifications cover both material and methods.
3. The primary goal of beyond compliance specification is to reduce the use of products or methods which have negative health and environmental impacts both during and after construction. These considerations may include full life cycle impacts, associated with raw materials, manufacturing, transport, deconstruction and their eventual fate.
4. These specifications will specifically address primary categories of readily identifiable products, ingredients and methods.
5. These provisions apply to both indoor and outdoor applications equally.

1.4 Exceptions

1. These specifications recognize that not all substitutes are equal and therefore exceptions can be made based on substantive evidence of necessary and superior performance. Special considerations may be given to restricted substances when secondary provisions are made such as sealed in place (contained) applications. All such exceptions must be approved in writing by the Architect.

PART 2 - MATERIALS

2.1 Products or Substances to be Avoided or Limited in Use

1. No product containing the following substances may be used on this project when an equivalent product without or with a lower concentration of this substance is suitable and available. All products containing substances which are known to cause health effects including but not limited to cancer, mutagenic, neurological, or behavioral effects should be avoided if suitable substitutes not containing or containing lower concentrations are available. This provision shall be limited to information contained on Material Safety Data Sheets, therefore MSDS sheets must be reviewed for all products for which such sheets are required. Applications for exceptions must be accompanied by related MSDS and product application and performance sheets, clearly showing a need for the exception.

2.2 Volatile Organic Compounds

1. No product containing volatile organic compounds (in over simplified terms volatile petro chemical or similar plant derived solvents) may be used on this project when a suitable non VOC or failing that a low VOC substitute is available. Manufacturers may refer to the U.S. EPA definition of VOC's for guidance or alternatively use the low molecular weight organic compound descriptor.

Example: Paints, Coatings, Primer, Adhesives, Chalks, Firestops, etc.

2. Waterborne equivalents are available for most of the solvent borne products used in construction and in most cases would be the preferred alternative. Waterborne products may in some instances have high VOC contents, therefore the fact that a product is waterborne does not automatically make it acceptable.

2.3 Chlorinated Substances

1. Poly Vinyl Chloride (vinyl) and other chlorinated products should be avoided if suitable substitutes are available.

2.4 Plasticizers

1. Plasticisers which offgass (low molecular weight) should be avoided.

2.5 Man Made Mineral Fibres

1. Products containing mineral fibres which can be emitted or abraded should be avoided.

Examples: duct liner, mineral fibre ceiling tiles, etc.

2.6 Radiation

1. Products or methods which result in the lowest emission of Electro Magnetic Fields are preferred.

2.7 Biocides

1. Products containing biocides (pesticides, miticides, mildewicides, fungicides, rodenticides, etc.) are not to be used if suitable alternatives are available. Highly stable, low human toxicity biocides such as Portercept may be acceptable substitutes. Biocide formulas which break down, emit powders or offgass should be avoided.

2.8 Heavy Metals

1. Heavy metals such as lead, cadmium, mercury etc. should be avoided.

2.9 Aluminum

1. Raw aluminum should be avoided, anodized or factory painted aluminum is acceptable. This is particularly applicable to surfaces which people can touch.

2.10 Ozone Depleting Substances

1. Products which contain or which use Ozone Depleting Substances such as Bromide, Chlorofluorocarbons (CFC) or Hydrofluorocarbons (HFC) etc. should be avoided if suitable substitutes are available.

2.11 Greenhouse Gasses

1. Products which contain, use or generate Greenhouse gasses such as CO₂ should be avoided if suitable substitutes are available.

2.12 Bituminous (tar) Products

1. Products containing tar compounds should not be used if suitable substitutes are available.

2.13 Chemical Compounds

1. Products containing the following chemical compounds should not be used if suitable substitutes are available: Neoprene, Latex, Butyl, ABS, Formaldehyde.

2.14 Adhesives

1. Adhesives containing solvents or other non preferred ingredients should be avoided if suitable substitutes are available, including systems designs which do not need adhesives or can use mechanical etc. fastening alternatives

2.15 Composite Products

1. Some composite products contain adhesives such as formaldehyde which are not preferred, and some composites such as Fibre Reinforced Plastics are not practical for recycling. These products should be avoided if suitable substitutes are available.

2.16 Cleaners and Solvents

1. Products, equipment, and methods which require the use of cleaners and solvents are not preferred if suitable substitutes are available. Examples of preferred products would include No Wax floors, or primerless caulks and adhesives, or products not requiring caulks and adhesives.

End of Section

1.1 Fires

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

1.2 Disposal of Wastes

1. Do not bury rubbish and waste materials on site.
2. Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

1.3 Drainage

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

1.4 Site Clearing and Plant Protection

1. Protect trees and plants on site and adjacent properties, which are to be retained.
2. Wrap in burlap trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m.
3. Protect roots of trees to drip line during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.

1.5 Pollution Control

1. Install and maintain temporary erosion and pollution control features as requested by local Municipal and Regional Authorities.
2. Install, maintain, restore, replace sediment control fence as required by Municipal and Regional authorities. The fence shall be in accordance with Municipal standards.
3. Install, maintain, restore, replace roadside catchbasin sediment protection at all street catchbasin in accordance with Municipal standards.
4. Install, maintain, restore, replace catchbasin sediment barrier immediately after installation of catch basins on the property in accordance with Municipal Standards.

-
5. Install and maintain a mud mat at the construction access, consisting of 30m x 5m x 0.45m clear stone and mud mats. Refer to site plan for location.
 6. Control emissions from equipment and plant to local authorities' emission requirements.
 7. Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

End of Section

1. General

1. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
2. Store volatile wastes in covered metal containers and remove from premises daily.
3. Prevent accumulation of wastes which create hazardous conditions.
4. Provide adequate ventilation during use of volatile or noxious substances.

2. Materials

1. Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
2. Provide on-site dump containers for collection of waste materials, and rubbish.

3. Cleaning During Construction

1. Maintain project grounds, and public properties free from accumulations of waste materials and rubbish.
2. Remove waste materials, and rubbish from site.
3. Vacuum clean interior building areas when ready to receive finish painting, and continue vacuum cleaning on an as-needed basis until building is ready for substantial completion or occupancy.
4. Schedule cleaning operations so that resulting dust and other contaminants will not fall on wet, newly painted surfaces.

4. Final Cleaning

1. At completion of Work, remove waste materials, rubbish, tools, equipment, machinery, and surplus materials, and clean all surfaces exposed to view; leave project clean and ready for occupancy.
2. Employ experienced workers, or professional cleaners, for final cleaning.
3. In preparation for Substantial Performance or Fitness for Occupancy status, whichever occurs first, conduct final inspection of interior and exterior surfaces exposed to view, and of concealed spaces.
4. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from all sight-exposed interior and exterior finished surfaces; polish resilient and ceramic surfaces so designated to shine finish. Vacuum carpet.
5. Clean and polish glass and mirrors.

-
6. Repair, patch and touch-up marred surfaces to specified finish, to match adjacent surfaces.
 7. Broom-clean paved surfaces; rake clean other surfaces of grounds.
 8. Clean exposed ductwork and structure.
 9. Replace filters.
 10. Clean bulbs and lamps and replace those burned out.
 11. Clean diffusers and grilles.
 12. Clean sinks, faucets, and water closets and controls.
 13. Maintain cleaning until project, or portion thereof, is occupied by Owner.
 14. Owner will arrange and pay for final waxing of new floors.

End of Section

1. Requirements Included

1. Record documents, samples, and specifications.
2. Equipment and systems.
3. Product data, materials and finishes, and related information.

2. Quality Assurance

1. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
2. Owner will arrange for testing of two windows at random. The owner does not pay for tests that result in a fail and re-testing will be at the expense of the General Contractor. Following retesting of a failed window, one additional window will be selected for testing at random.

3. Format

1. Organize data in the form of an instructional manual.
2. Binders: commercial quality, 8½" x 11" maximum 2½" ring size.
3. When multiple binders are used, correlate data into related consistent groupings.
4. Cover: Identify each binder with type or printed title "Project Record Documents", list title of Project, identify subject matter of contents.
5. Arrange content under Section numbers and sequence of Table of Contents.
6. Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
7. Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

4. Contents, Each Volume

1. Table of Contents: Provide title of project; names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
2. For each Product or System: list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
3. Product Data: mark sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
4. Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

5. Typed Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

5. Submission

1. Submit one copy of completed volumes in final form 15 days prior to substantial performance. For equipment put into use with Owner's permission during construction, submit Operating and Maintenance Manuals within 10 days after start-up. For items of Work delayed materially beyond date of Substantial Performance, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.
2. Copy will be returned after inspection, with Consultant comments.
3. Revise content of documents as required prior to final submittal.
4. Submit two copies of revised volumes of data in final form within ten days after final inspection.
5. For contract drawings (architectural, landscaping, structural, mechanical, electrical), transfer neatly as-built notations onto second set and submit both sets.
6. Prepare digital pdf file for submission on CD or USB of completed closeout documents.

6. Record Documents and Samples

1. In addition to requirements in General Conditions, maintain at the site for Owner one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda
 - .4 Change Orders and other modifications to the Contract.
 - .5 Reviewed shop drawings, product data and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
2. Store Record Documents and Samples in Field Office apart from documents used for construction. Provide files, racks, and secure storage.
3. Label and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "Project Record" in neat, large, printed letters.
4. Maintain Record Documents in a clean, dry, and legible condition. Do not use Record Documents for construction purposes.
5. Keep Record Documents and samples available for inspection by consultant.

7. Recording As-Built Conditions

1. Consultant will provide one (1) complete set of white prints of project drawings and one (1) complete set of specifications for the purpose of recording as-built conditions. Mark and record one set on an on-going basis as construction proceeds. **Near the end of the construction period transfer all marks neatly to set for submission as project record documents.**
2. Refer to drawings/specifications for additional mechanical and electrical requirements.
3. Record information concurrently with construction progress. Do not conceal work until required information is recorded.
4. Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measure 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 catalog number of each project actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and Change Orders.
6. Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

8. Digital As-Built Drawings

1. Retain the services of a CAD drafting company acceptable to the consultant to prepare digital CAD As-Built documents for all Architectural and Engineering drawings.
2. After the consultant has found the Redlined As-Built drawings to be acceptable, transfer to digital file all information recorded on As-Built drawings. Layering of information as per consultant's instructions.

9. 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 nomenclature and commercial number of replaceable parts.
2. Panelboard 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 instruction. Include summer, winter, and any special operating instructions.
5. Maintain Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair and reassemble 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 lists, illustrations, assembly drawings, and diagrams required for maintenance.
10. Provide installed control diagrams by controls manufacturer.
11. Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
12. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
13. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
14. Include test balancing reports as specified in mechanical specifications.
15. Additional Requirements: As specified in individual specification sections.

10. Materials and Finishes

1. Building Products, Applied Materials, and Finishes: include product data, with catalog number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
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 recommend schedule for cleaning and maintenance.
4. Additional Requirements: as specified in individual specifications sections.

11. Guarantees, Warranties and Bonds

1. Separate each warranty or bond with index tab sheets keyed to the List of Contents listing.
2. List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal. Use Guarantee/Warranty Form as provided in Section 01721 whenever standard preprinted trade or manufacturer's Guarantee/Warranty forms are not available.
3. Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.
4. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.
5. Verify that documents are in proper form, contain full information, and are notarized.
6. Co-execute submittals when required.
7. Retain warranties and bonds until time specified for submittal.

End of Section

1. Notes

1. To be made out on the letterhead of Guarantor or Warrantor which usually is a Subcontractor.
2. This format is to be used only when standard preprinted trade or manufacturer's forms are not available. Preprinted forms are to include all elements of information shown on this sample or as a minimum.
3. Comply with Requirements for Guarantee/Warranty as specified in Section 01720, Article 10.

To: Waterloo Catholic District School Board
35 Weber Street West Kitchener, Ontario N2H 3Z1

Date: _____

SECTION _____

TITLE _____

GUARANTEE/WARRANTY TO:

OWNER Waterloo Catholic District School Board

PROJECT St. Aloysius CES Addition and Renovations

ARCHITECT Grguric Architects Incorporated

REFERENCE (to specifications or drawings)

TIME Period of Guarantee/Warranty: _____ years

GUARANTEE/ Starting Date: Substantial Performance as certified by Architect

WARRANTY

Date: _____

(Description of Guarantee/Warranty)

Upon written notification from the Owner or the Consultant that the above work is defective any repair or replacement work required shall be to the Consultant's satisfaction at no cost to the Owner.

This guarantee shall not apply to defects caused by the work of others, maltreatment of materials, negligence or Acts of God.

SUBCONTRACTOR

Signature

Date

Authorized Signing
Officer:

(Name Printed)

Title

Name of Firm:

Address:

Telephone Number

CONTRACTOR

Signature

Date

Authorized Signing
Officer:

(Name Printed)

Title

Name of Firm:

SEAL

Address:

Telephone Number

End of Section

1. Maintenance Manual

1. On completion of project, submit to Architect two (2) copies of Operations Data and Maintenance Manual in English, made up as follows:
 - .1 Bind data in vinyl hard covered, 3 ring loose leaf binder for 8½" x 11" size paper.
 - .2 Enclose title sheet, labeled "Operation Data and Maintenance Manual", project name, date and list of contents.
 - .3 Organize contents into applicable sections of work to parallel project specification break-down. Mark each section by labeled tabs protected with celluloid covers fastened to hard paper dividing sheets.
 - .4 A digital copy of all documents in the operations and manuals must be provided on a CD or USB, format to be PDF.
2. Include following information, plus data specified.
 - .1 Maintenance instructions for finished surface and materials.
 - .2 Copy of hardware and paint schedules.
 - .3 Description, operation and maintenance instructions for equipment and systems, including complete list of equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.
 - .4 Names, addresses and phone numbers of sub-contractors and suppliers.
 - .5 Guarantees, Warranties and bonds showing:
 - .1 Name and address of project.
 - .2 Guarantee commencement date (date of Final Certificate of Completion).
 - .3 Duration of guarantee.
 - .4 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.
 - .5 Signature and seal of Contractor.
 - .6 Additional material used in project listed under various Sections showing name of manufacturer and source of supply.
3. Neatly type lists and notes. Use clear drawings, diagrams or manufacturers' literature.
4. Include in the Manuals a complete set of final shop drawings indicating corrections and changes made during fabrication and installation.

End of Section

1. General

1. **Bonds:** Refer to Supplementary General Conditions and to Standard Contract Document RAIC DOCUMENT SIX 2022 Digital Edition for bonding requirements for this project, both at the time of tender submission and throughout the duration of the construction period.

2. Standard Warranty

1. Refer to Supplementary General Conditions and to Standard Contract Document RAIC DOCUMENT SIX 2022 Digital Edition for warranty requirements and conditions for the standard warranty which is required for the work of this contract.

NOTE: The General Contractor will be responsible to attend the 11-month warranty walkthrough meeting as required by the Owner. The Owner will submit Warranty Service Call Request forms during the warranty period to the General Contractor as required that the GC must complete and return to the Owner and Consultant as required.

3. Extended Warranties

1. Refer to individual specifications sections for requirements of extended warranties required for particular sections or items of work.
2. Extended warranties are required to be issued by manufacturers, fabricators, suppliers and/or installers, sometimes jointly, due to their unique position in the construction process and their ability to guarantee a particular section of work. Refer to individual requirements of extended warranties requested.
3. Unless specifically noted otherwise, all extended warranties shall commence on the date of Substantial Performance of the Work as certified by the Consultant.
4. Listed below is a summary of extended warranties required for individual Sections. This list, if inconsistent with the specified requirements of individual extended warranties, shall be deemed correct with respect to length of extended warranties. Extended warranties required shall include, but not be limited to, the following:

Extended warranties (total warranty period listed, including entire building warranty)

Asphalt Paving (Section 02600)	2 years
Millwork (Section 06400)	2 years
4-Ply Bituminous Roofing	refer to Section 07520
Sheet Metal Flashing and Trim (07620)	2 years
Caulking (Section 07900)	5 years
Joint Sealers for Roofing (Section 07901)	2 years
Commercial Steel Doors and Frames	refer to Section 08100
Aluminum Windows and Doors (Section 08520)	10 years
Glazing (Section 08800)	5 years
LVT Flooring	3 years
Floor Porcelain Tile (section 09330)	3 years

Acoustic grids and tiles (Section 09510)	2 years
Painting (Section 09900)	2 years

End of Section

1.1 Description of Work

1. This Section includes parameters for the general design and performance for the work of Sections which comprise the building envelope including but not limited to, masonry cavity walls, metal cladding, soffits, windows, entrances and roofing.
2. Performance of the building envelope shall be guaranteed by the Contractor.

1.2 Design

1. **General:** Design and engineer as required, fabricate, erect, and/or install building envelope in compliance with the Ontario Building Code, other regulations and requirements of authorities having jurisdiction.
2. Take into account construction tolerance limitations, creepage, deflection and other movements of the structure.
3. Accommodate, by means of expansion and contraction provisions, any movement in the building envelope assemblies themselves and between the assemblies and the building structure. Allow for expansion and contraction of components caused by ambient temperature range, surface temperature variation of components, wind, seismic forces, structural deflection and racking; without causing misalignment of joints, breakage of joints and air/vapour barriers, water and air penetration through the assembly, glass breakage, or other defects detrimental to appearance or performance.
4. Method of attachment to the structure shall take into account site peculiarities so that site and air vibrations or normal temperature movements of the building do not loosen, weaken and/or fracture the connection between building envelope assembly components and the structure or between the components themselves.
5. Reinforce building envelope assembly components, as required, so that the members can safely sustain design loads.
6. Assemble and secure assemblies in manner which will keep stresses on sealants within the sealant manufacturer's recommended maximum performance levels.
7. **Rain Screen Principle:** Except where detailed otherwise, construct building envelope assemblies based on the "Rain Screen" principle as advocated by the National Research Council of Canada. All voids between the assembly components as well as those between components and the structure shall have:
 - .1 gaskets, baffles, overlaps, seals and compartmentalization as required to provide a barrier "Rain Screen" to effectively prevent excessive rain water entry into any of the building envelope cavities but to allow pressure equalization of cavity air spaces.

- .2 air barriers and seals are required to prevent entry of interior building air into building envelope cavities, and exterior air into the building. Air barriers and seals shall be able to withstand wind design pressures.
- .3 such provisions in the form of openings between cavities and the building exterior of sufficient cross sections to provide adequate pressure equalization. All openings shall be effectively baffled against direct rain water entry. Air spaces shall be baffled and compartmentalized to prevent chimney effect within the air spaces vertically and horizontally.
- .4 Thermal separators, isolators and seals placed to eliminate contact between interior humid air and a cold surface or structural component to prevent condensation and ice build-up on such surfaces during cold weather.

1.3 Water, Vapour and Moisture

1. Comply with the design and performance requirements specified in the building code, and as specified herein, including the following principles:
2. Drain to the exterior face of the assembly, any water entering at joints and any condensation occurring within the building envelope assembly.
3. Design, fabricate and install the assembly to be watertight to the interior under the interior and exterior design conditions in combination with movements occurring due to loads imposed.
4. At design conditions no water penetration to the building interior side of the assembly shall occur.
5. The requirements for an air barrier and a vapour barrier are intended to be provided at the same plane in the building envelope design unless otherwise indicated or specified. In such cases, the Drawings and Specifications refer to "air/vapour barrier". The definition of the air/vapour barrier for the purpose of these Specifications is "a continuous membrane including joints of membrane between components and to adjacent construction which prevents or retards penetration of moisture laden air and the diffusion of water vapour through it".
6. The maximum water vapour transmission of all components forming the vapour barrier shall be (1.72 ng/Pa x s x sq.m.) (0.3 Imperial Perms) unless specified otherwise.
7. At design conditions no condensation shall occur on room side surfaces.
8. Sound: Provide completed installations free from vibrations, wind whistles and noise due to thermal and structural movement and wind pressure.
9. Seismic: Fabricate and erect cladding assemblies to prevent damage due to earthquake forces as required by The Ontario Building Code.

1.4 Quality Control

1. **General:** Materials and workmanship shall be subject to inspection at any time. Cooperate in permitting access for inspection to all places where work is being done or stock is being stored.
2. Owner's quality control inspection and testing is specified in the technical sections and will be paid from Cash Allowance except as otherwise specified. Pay for inspections and retesting to verify acceptability of corrected work.
3. Allow sufficient time for testing, evaluation, alterations and retesting so as not to interrupt the Progress Schedule for the Project.
4. The Consultant may require testing of connections and special prefabricated inserts, as part of the work of this Section.

1.5 Sealants

1. Sealants used for the various building envelope assemblies shall be selected from those specified in the respective assembly Section, and shall be coordinated with the sealant being provided under other building envelope Sections. Preferably, one sealant by the same manufacturer shall be used throughout. If different sealants are selected, from those specified, it is the responsibility of the respective Section to ensure compatibility between selected sealant, substrates, and sealants of other Sections which come in contact with the selected sealant.

End of Section

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

1. Not applicable.

1.2 Existing Conditions

1. Take over structures to be demolished based on their conditions (on date that tender is accepted).

1.3 Demolition Drawings

1. Where required by authorities having jurisdiction, submit for approval drawings, diagrams or details clearly showing sequence of disassembly work or supporting structures.

1.4 Protection

1. Prevent movement, settlement or damage of adjacent grades. Provide bracing, shoring as required.
2. Prevent debris from blocking surface drainage inlets which must remain in operation.
3. Protect existing items designated to remain and materials designated for salvage. In the event of damage to such items, immediately replace or make repairs to approval of Owner and at not cost to Owner.

PART 2 - PRODUCTS

1. Not applicable.

PART 3 - EXECUTION

3.1 Work

1. Dispose of demolished materials except where noted otherwise.

3.2 Safety Code

1. Unless otherwise specified, carry out demolition work in accordance with Canadian Construction Safety Code 2010.
2. Should material resembling spray or trowel-applied asbestos be encountered, notify Architect. Any asbestos encountered will be removed by the Owner's Contractor.

3.3 Preparation

1. Disconnect electrical and telephone service lines entering areas to be demolished as per rules and regulations of authorities having jurisdiction. Post warning signs on electrical lines and equipment which must remain energized to serve other areas during period of demolition.
2. Inspect site and rectify with Architect items designated for removal and items to remain.
3. Disconnect and cap mechanical services in accordance with requirements of local authority having jurisdiction.
4. Natural gas supply lines to be removed by gas company or by qualified tradesman in accordance with gas company instructions.

3.4 Demolition & Field Work

1. Demolish areas as indicated on the drawings.
2. Remove existing equipment, services and obstacles, where required, for refinishing or making good of existing surfaces, and replace same as work progresses.
3. At end of each day's work, leave work in safe condition so that no part is in danger of toppling or falling. Protect interiors of parts not to be demolished from exterior elements at all times).
4. Demolish in a manner to minimize dusting. Keep dusty materials wetted.
5. Demolish masonry and concrete walls in small sections. Carefully remove and lower structural framing and other heavy or large objects.
6. Burning materials on site is not permitted.
7. Remove contaminated or dangerous materials from site and dispose of in safe manner.
8. Employ rodent and vermin exterminators to comply with health regulations.

3.5 Salvage

1. Carefully dismantle items containing materials for salvage and stock pile salvaged materials at locations as directed by Architect.

3.6 Restoration

1. Upon completion of work, remove debris, trim services and leave work site clean.
2. The General Contractor is responsible for watering and maintaining all new and restored sod. A site meeting will be scheduled by the GC at least six weeks following installation to demonstrate to the Owner that roots have established before releasing the final amounts as determined by the Consultant.
3. The General Contractor is responsible for any temporary fencing required to prevent foot traffic on all new and restored sod.

4. Reinstall areas and existing works outside areas of demolition to match condition of adjacent, undisturbed areas.

End of Section

PART 1 - GENERAL

1.1 General Requirements

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

1.2 Related Work Specified Elsewhere

1. Site Grading Section 02210
2. Excavation, Backfilling and Rough Grading Section 02220

1.3 Examination

1. Examine the Drawings, Specifications, and Bore Hole data which show soil conditions at boreholes in locations shown on Drawings. Visit the site and determine the work extent and nature of the existing conditions. In no circumstances will any claims against the Owner be allowed resulting from failure to ascertain the work herein described or implied.
2. Report to the Consultant in writing any conditions which will prejudice the proper completion of the work of this Section. Commencement of work constitutes acceptance of existing conditions.

1.4 Protection

1. Establish locations of all electrical, telephone, or other service installations existing in the areas of site preparation by contacting the service owners and obtaining their approval to work in such areas. Contact the Municipality and local utilities to review proposed scheduling, work activities and regulations pertaining to all work beyond the limits of the property including but not limited to parking areas, stormwater outlet and headwall and asphalt driveway entrances. Provide adequate markers or take protective measures to ensure that no damage will be caused under this Section. Repair or replace damaged work as required without cost to the Owner.
2. Electronically locate, map and record location of services prior to doing any excavation.

1.5 Dust Control

1. Provide and maintain to the Consultant's satisfaction, adequate system to avoid any nuisance caused by dust and dirt rising throughout the area of operations.

1.6 Silt Control

1. Provide and maintain to the Consultant's and to the Authorities' satisfaction, control systems to prevent silt from entering any storm drainage system. Refer to Site Services Drawing for details.
2. General Contractor is responsible for regular maintenance of silt fence.

PART 2 - PRODUCTS

2.1 Materials

1. Not applicable.

PART 3 - EXECUTION

3.1 Disposal of Waste and Surplus Materials

1. Except where specified or indicated on Drawings to be retained on site, or to be reused, remove from the site, all waste and surplus materials resulting from site preparation work on a daily basis. Dispose of as required in accordance with local or provincial regulations. Under no circumstances shall the burning of rubbish be permitted on the site. Where items are to be reused, store on site where designated and provide temporary protection to same to prevent damage by construction operations.

End of Section

PART 1 - GENERAL

1.1 General Requirements

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

1.2 Related Work Specified Elsewhere

1. Site Grading:	Section 02210
2. Excavation, Backfilling and Rough Grading	Section 02220
3. Topsoil and Finish Grading:	Section 02260

1.3 Definitions

1. Clearing consists of cutting off trees and brush vegetative growth to not more than a specified height above ground and disposing of felled trees and surface debris.
2. Close-cut clearing consists of cutting off or removing at, or near flush with original ground surface standing trees, brush, scrub, roots, stumps and embedded logs and disposing of fallen timber and surface debris.
3. Clearing isolated trees consists of cutting off to not more than a specified height above ground of trees designated grubbing and disposing of felled trees and debris.
4. Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, and trees smaller than 50 mm diameter and disposing of all fallen timber and surface debris.
5. Grubbing consists of excavation and disposal of stumps and roots boulders and rock fragments to not less than a specified depth below original ground surface.

1.4 Protection

1. Prevent damage to fencing trees, landscaping, natural features, bench marks, existing buildings, existing pavement, utility lines, site appurtenances, water courses, root systems of trees which are to remain. Make good damage.
2. Apply approved tree paint to cuts or scars suffered by vegetation designated to remain.

PART 2 - PRODUCTS

2.1 Materials

1. Not applicable.

PART 3 - EXECUTION

3.1 Clearing

1. Clear trees, shrubs, uprooted stumps and surface debris not designated to remain.
2. Cut off trees, brush, and scrub as indicated or as directed at a height of not more than 300 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations may be 1000 mm.
3. Cut off unsound branches and cut down dangerous trees overhanging area cleared.
4. Close Cut Clearing
5. Cut off trees, shrubs, stumps and other vegetation at ground level to within 100 mm of original ground surface.
6. Perform close cut clearing by hand so that existing insulation of fibrous material is not damaged.
7. Cut off unsound branches and cut down dangerous trees overhanging area cleared.

3.2 Isolated Trees

1. Cut off isolated trees indicated or directed by Consultant at a height of not more than 300mm above ground.
2. Grub out isolated tree stumps.
3. Underbrush Clearing
4. Clear underbrush from areas indicated at ground level.

3.3 Grubbing

1. Grub out stumps and roots to not less than 400 mm below original ground surface.
2. Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 m³.

3.4 Removal and Disposal

1. Remove cleared and grubbed materials off site in a manner acceptable to Consultant and Municipal Authorities.
2. Usable timber and rocks become property of Contractor.

3.5 Finished Surface

1. Leave ground surface in a condition suitable for immediate grading operations or stripping of topsoil.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Clearing and Grubbing:	Section 02110
2. Site Grading:	Section 02210
3. Top Soil and Finish Grading:	Section 02260

PART 2 - PRODUCTS

1. Not applicable.

PART 3 - EXECUTION

3.1 Stripping of Top Soil

1. Remove top soil from areas to be excavated, paved and regraded.
2. Strip top soil when dry enough to prevent contamination of subgrade.
3. Stockpile top soil on site, where directed.
4. Remove from site existing grass and vegetation and surplus top soil, if any.

End of Section

PART 1 - GENERAL

1.1 General Requirements

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

1.2 Related Work Specified Elsewhere

1. Clearing and Grubbing:	Section 02110
2. Topsoil and Finish Grading:	Section 02260
3. Asphalt Paving:	Section 02600

1.3 Site Conditions

1. Refer to Section 00300.
2. Known underground and surface utility lines and buried objects are indicated on site plan. Confirm exact locations of utility lines and buried objects prior to machine excavation or grading.

1.4 Protection

1. Prevent damage to trees, natural features, bench marks, existing pavement, surface or underground utility lines which are to remain. Make good damage.

PART 2 - PRODUCTS

2.1 Materials

1. Fill material: Type "4" in accordance with Part 2 of Section 02220 – Excavation, Backfilling and Rough Grading.
2. Obtain approval of excavated or graded material used as fill for grading work. Protect approved material from contamination.

PART 3 - EXECUTION

3.1 Stripping of Topsoil

1. The original topsoil will be stripped from the site as part of the work described in Section 02120.

3.2 Grading

1. The Contractor shall use the information shown on the Drawings as well as the information observed during visits to the site during the Tender Period, as the basis for the "Existing Conditions" of the site.
2. Rough grade to levels, profiles, and contours allowing for surface treatment as indicated. Ensure that rough grading operations to not promote water ponding in construction areas. Level depressions with Type "4" fill if suitable compaction can be demonstrated.
3. Perform construction grading and/or pre-grading to allow proper construction access to the Work. Grade site to accommodate vehicle movement, materials, handling and storage and placement of granular base materials (to be used during the construction period).
4. Grade to prevent water ponding on site during construction period. Create additional ditches, swales, slopes, ponds, etc. as required by Contract Documents and Municipal Authorities for control of drainage, sedimentation and topsoil retention.
5. Rough grade to following depths below finish grades:
 - 150 mm for grassed areas.
 - 450 mm for flowerbeds.
 - 600 mm for shrub beds.
 - 540 mm for heavy duty asphalt paving.
 - 420 mm for medium duty asphalt paving.
 - 275 mm for concrete walks and/or unit paving.

Note that the rough grading elevations listed above are nominal.

6. Slope rough grade away from building 1:50 minimum.
7. Grade swales and ditches to profiles and depths indicated.
8. Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
9. Compact filled and disturbed areas to maximum dry density to ASTM D698-78, as follows:
 - 90% under landscape areas.
 - 98% under paved and walk areas and playing fields.
10. Do not disturb soil within branch spread of trees or shrubs to remain.

3.3 Testing

1. Inspection and testing of soil compaction will be carried out by designated testing laboratory as directed by Consultant.
2. Costs of tests will be paid by a Cash Allowance specified in Section 01020.

3.4 Surplus Material

1. Remove surplus material from site in a manner acceptable to Consultant and Municipal Authorities.
2. Remove material unsuitable for fill, grading or landscaping from site in a manner acceptable to Consultant and Municipal Authorities.

End of Section

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

1. Excavation and Backfill for Mechanical and Electrical:	Divisions 15 & 16
2. Safety Requirements:	Section 01545
3. Environmental Protection:	Section 01575
4. Top Soil and Finish Grading:	Section 02260

1.2 Shoring, Bracing & Underpinning

1. Prevent movement or settlement, safeguard and maintain integrity of adjacent structures, earth, bench marks, services, walks, paving, trees, bearing piles, curbs, landscaping, adjacent grades. Provide bracing, shoring and underpinning required.
2. Shore and brace excavations to prevent failure in accordance with Canadian Construction Safety Code 1977 and applicable local regulations.
3. Make good and pay for any damage and be liable for any injury resulting from inadequate shoring, bracing or underpinning.

1.3 Utility Lines

1. Before commencing work, establish location and extent of underground utility lines in area of excavation. Notify Architect of findings.
2. Known underground and surface utility lines and buried objects are indicated on site plans. No guarantee is given of completeness and accuracy.
3. Make good and pay for damage to existing utility lines resulting from work.

1.4 Protection

1. Protect bottoms of excavations from softening. Should softening occur, remove softened soil and replace with footing concrete.
2. Protect bottoms of excavations from freezing.
3. Construction banks in accordance with local by-laws.
4. Provide adequate protection around bench markers, layout markers, survey markers, and geodetic monuments.
5. Provide protection to ensure no damage to existing facilities and equipment situated on site.
6. Effect approved measures to minimize dust as a result of this work.

7. Do not stockpile excavated material to interfere with site operation or drainage.

1.5 Compaction Densities

1. Compaction densities are percentages of maximum densities obtainable from ASTM D698-70.

PART 2 - PRODUCTS

2.1 Materials

1. See Soil Report for suitability of existing soil as fill. Excavated or graded material to be approved before use as fill. Protect such approved material from contamination.
2. **Type 1 Fill:** Clean, graded 20 mm clear crushed stone. Containing less than 10% passing the No. 4 sieve.
3. **Type 2 Fill:** Clean, natural river sand and gravel material, free from silt, clay, loam friable or soluble materials and organic matter, graded within the limits of MTC granular class "B" material.
4. **Type 3 Fill:** Concrete backfill 15 Mpa strength at 28 days complying with the requirements of Section 03300.
5. **Type 4 Fill:** Excavated pervious soil free from roots, rocks larger than 75 mm and building debris. If sufficient quantity of material is not available from excavation, use imported fill having same or better characteristics.
6. **Type 5 Fill:** Fine grain material such as clay, that is relatively impervious to the flow of water.

2.2 Stockpiling

1. Stockpile fill materials in areas designated by Architect. Stockpile granular materials in manner to prevent segregation. Protect stockpiled fill material from freezing.
2. Protect fill materials from contamination.
3. General Contractor is responsible for restoring all surfaces following stockpiling of fill materials.

PART 3 - EXECUTION

3.1 Preparation

1. **Lines and Levels:** Establish accurate lines and levels as required. Supply batter board, line stakes and templates. Establish permanent reference lines and bench marks required.

2. Prevent damage to sides and bottoms of excavated pits and trenches from exposure to sun and rain which would cause cave-ins or softening of beds on which foundations and drains rest.
3. **Keep excavations free of water while work is in progress:** Prevent flow of water and earth fines into excavated pits and trenches. Seal or divert flow from springs that fill excavations.
4. Bail, pump out or divert water from excavations, from whatever cause, as it accumulates, and until the permanent drainage is operational and foundations are in place.

3.2 Excavating

1. Excavate to elevations and dimensions indicated for installation, construction and inspection of work.
2. Excavate to well defined lines to minimize quantity of fill material required.
3. Earth bottoms of excavations to be dry, undisturbed soil, level, free from loose or organic matter.
4. Excavation must not interfere with normal 45 deg. splay of bearing from bottom of any footing.
5. Correct unauthorized excavation at no extra cost as follows:
 - .1 Fill under bearing surfaces and footings with type 3 fill.
 - .2 Fill under other areas with Type 2 fill compacted to 100% density.
6. Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw. Seal cuts with approved tree wound dressing.
7. Remove paving, walks, rubble and other obstructions encountered in course of excavation.
8. Keep a record of founding elevations of footings. This record must be approved by the *Consultant* before claims for extra will be considered.
9. Extras will be paid only if, upon excavating to the specified founding elevations, it is found that conditions do not meet the requirements set forth in the *Contract Documents*. No extras will be paid if footings are lowered due to construction activity, over excavation, or through undermining by the installation of electrical and mechanical services.
10. Use hand methods to carry out final trimming of footing beds, prior to placement of reinforcement and concrete. Accurately level the bottom of footing excavations.
11. Remove water, disturbed soil or foreign matter from footing excavations before placing reinforcement or concrete.
12. Footings are not to be concreted until the soil at founding elevation is inspected and approved by the geotechnical engineer.

3.3 Backfilling

1. Do not commence backfilling until areas of *Work* to be backfilled have been inspected, and pipe and conduit joints tested and accepted by *Consultant*.
2. Areas to be backfilled shall be free from debris, snow, ice, water or frozen ground. Backfill material shall not be frozen or contain ice, snow or debris.
3. Prior to placing fill under slabs on grade, compact existing subgrade to obtain same compaction, as specified for fill. Remove “soft” material and fill with approved material.
4. Prior to installation of foundations compact existing subgrade to obtain bearing capacity. Remove soft material and fill with approved material.
5. Backfill simultaneously each side of walls and other structures to equalize soil pressures.
6. Request reviews by *Consultant* and geotechnical engineer of excavation prior to beginning backfilling.
7. Obtain Consultant’s acceptance prior to placing backfill against basement walls.
8. Where temporary unbalanced earth pressures are liable to develop on walls or the structures, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Architect.
9. Place and compact fill materials in continuous horizontal layers not exceeding 200 mm loose depth. Do not disturb or damage buried services, drainage system, waterproofing and dampproofing. Make good any damage.
10. Do not use frozen material for backfilling or filling.

3.4 Fill Locations & Compaction

1. **Type 1 Fill:**
 - .1 Use under interior concrete slabs on grade to a minimum compacted depth of 200 mm.
 - .2 Use under all exterior concrete slab on grade to a minimum compacted depth of 150 mm.
 - .3 Compact to at least 100% standard proctor maximum dry density.
2. **Type 2 Fill:**
 - .1 Use within building area, in trenches, pits and fill for over-excavated areas to underside of type 1 Fill.
 - .2 Compact to at least 100% standard proctor maximum dry density.
3. **Type 3 Fill:**

.1 Use under foundations where specified.

4. Type 4 Fill:

- .1 Use at exterior side of perimeter walls to subgrade level.
- .2 Use on backside of retaining walls to subgrade level on high side for minimum 500 mm from wall. Compact to 95% standard proctor maximum dry density.

5. Type 5 Fill:

- .1 Use at perimeter of building at weeping tile location, above type 2 fill, in landscaped areas prior to placing top soil – See Section 02411.

3.5 Grading

1. Rough grade to levels, profiles, and contours allowing for surface treatment as indicated. Under paved areas, subgrade must be properly shaped and crowned to provide drainage of the sub-base to the catch basins and to the sub-drainage system. Cross fall to be 2% minimum.
2. Slope rough grade away from building 1:50 minimum.
3. Grade ditches to depth required for maximum run-off.
4. Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Moisture content of fill and existing surface to be approximately the same to facilitate bonding.
5. Compact filled and disturbed areas to standard proctor maximum dry density to ASTM D698-78 as follows:
 - .1 95% under landscaped area.
 - .2 100% under paved and walk areas and under sports field.
6. Do not disturb soil within branch spread of trees or shrubs to remain.

3.6 Inspection & Testing

1. Refer to Section 01005, Paragraph 19.

3.7 Surplus Material

1. Dispose of surplus material from site.
2. Dispose of material unsuitable for fill, grading or landscaping from site.

End of Section

PART 1 - GENERAL

1.1 Related Work in Other Sections

1. Site Grading:	Section 02210
2. Excavation, Backfilling and Rough Grading :	Section 02220

1.2 Landscape Sub-Contractor's Work

1. The work of the following sections must be performed by one only subcontractor referred to as the landscape sub-contractor.
 - Section 02260 Top Soil and Finish Grading
 - Section 02487 Sodding
 - Section 02490 Trees, Shrubs and Groundcovers

1.3 Quality Assurance

1. Should the source of topsoil be exhausted, test topsoil from new source, submit soil analysis report and recommendations for correction and obtain the approval from the Consultant before using.
2. Obtain approval of the topsoil in writing from the Consultant.
3. Test topsoil for NPK, Mg, Soluble salt content, organic matter, pH and permeability.
4. Submit 2 copies of the soil analysis report and recommendations for correction to the Consultant.

1.4 Product Delivery, Storage and Handling

1. Stockpile topsoil in locations designated by the Consultant.
2. Do not spread topsoil in a frozen or muddy condition.

1.5 Site Conditions

1. Should the source of topsoil be exhausted, test topsoil from new source, submit soil analysis report and recommendations for correction and obtain the approval from the Consultant before using.
2. Prevent damage to existing buildings, sidewalks, pavement, utility lines, servicing and other existing structures which are to remain.
3. Do not bury foreign material beneath areas to be landscaped. Dispose of debris prior to topsoil placement and remove from the site.

1.6 Product Delivery, Storage and Handling

1. Stockpile topsoil in locations designated by the Consultant.

2. Do not spread topsoil in a frozen or muddy condition.

PART 2 - PRODUCTS

2.1 Materials

1. Topsoil: From stockpile stripped from site.
2. Imported Topsoil: A fertile, friable natural loam; containing not less than 4% organic matter for lay loams and not less than 2% organic matter for sandy loams to a maximum of 15%, and capable of sustaining vigorous plant growth, free of subsoil contamination, roots and stones over 50mm in diameter, reasonably free of weeds (as determined by the Consultant), and having a pH ranging from 6.0 to 7.5.

PART 3 - EXECUTION

3.1 Preparation

1. All subgrade shall be approved by the Consultant before the placement of topsoil.
2. Fine grade the subgrade eliminating uneven areas and filling low spots. Remove all debris and all subsoil that has been contaminated with oil or gasoline.
3. Compact finished subgrade to 95% Standard Proctor Dry density for areas under sod or planting.
4. Scarify subgrade to a depth of 100mm.
5. Topsoil to be compacted to a firmness sufficient to show a heel imprint of not more than 3mm deep. The top 50mm of topsoil shall be of a fine texture suitable for placement of sod.
6. Manually spread topsoil around trees and plants to prevent damage by grading levelling equipment.
7. Float the area until surface is smooth. Cut smooth falls to catch basin rims and finish up flush.
8. Do not cover catch basins, valve covers or inspection pits
9. Fine grade the topsoil to ensure positive drainage away from buildings and sidewalks; provide positive drainage from curb edges.
10. Leave surface smooth, uniform and sufficiently firm to prevent sinkage pockets when irrigated.
11. Obtain approval of topsoil grading prior to the placing of plant material or sod.

3.2 Spreading of Topsoil

1. Spread dry topsoil during dry weather over approved, dry, unfrozen subgrade where sod is indicated.
2. Keep topsoil 20mm below finished grade for sodded areas.
3. Apply topsoil to the following minimum compacted depths:
150mm for seeded areas
150mm for sodded areas
450mm for flower beds
600mm for shrub beds
4. Fine grade topsoil eliminating rough and low areas and to ensure positive drainage.
5. Roll topsoil with a 50kg roller to compact and retain surface. Compact to 85% SPD

3.3 Raking-Out

1. Hand rake areas as a final surface preparation.
2. Coordinate the scheduling of hand raking to ensure that sodding can occur as soon as possible after hand raking.

3.4 Clean-Up

1. Make good any damage caused by topsoil spreading activities at no extra cost.
2. Clean up immediately any soil or debris spilled onto pavement or concrete.

End of Section

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

1. Site Grading:	Section 02210
2. Topsoil and Finish Grading :	Section 02260

1.2 Landscape Sub-Contractor's Work

1. The work of the following sections must be performed by only one subcontractor referred as the landscape sub-contractor.
 - Section 02260 Top Soil and Finish Grading
 - Section 02487 Sodding
 - Section 02490 Trees, Shrubs and Groundcovers

1.3 Quality Assurance

1. Laying of sod to be carried out by experienced personnel under the direction of a skilled foreman.

1.4 Delivery & Storage

1. Schedule deliveries in order to keep storage at jobsite to minimum without causing delays.
2. Deliver, unload and store sod on pallets.
3. Deliver sod to site within 24 h of being lifted and lay sod within 36 h of being lifted.
4. Do not deliver small, irregular or broken pieces of sod.
5. During wet weather, allow sod to dry sufficiently to prevent tearing during lifting and handling.
6. During dry weather protect sod from drying and water sod as necessary to ensure its vitality and prevent dropping of soil in handling. Dry sod will be rejected.

1.5 Scheduling of Work

1. Schedule placing of topsoil and finish grading to permit sodding immediately.

1.6 Inspection

1. Obtain approval of the Consultant of the finish topsoil surface before proceeding with sodding.

PART 2 - PRODUCTS

2.1 Materials

1. **Nursery Sod:** Quality and source to comply with standards outlined in "Guide Specification for Nursery Stock," Section 17, 1978 Edition, published by Canadian Nursery Trades Association.
 - .1 Number one (#1) Kentucky Bluegrass/Fescue Sod: Sod grown from minimum 40% Kentucky Bluegrass, 30% Creeping Red Fescue.
2. **Water:** Potable.
3. **Herbicide:** Standard commercial (Canada Pest Control Products Act).
4. **Fertilizer:** Complete synthetic slow release fertilizer with maximum 35% water soluble nitrogen. Formulation ratio 20-10-10 brand name fertilizer for application during maintenance period.
5. **Topsoil:** For sodding and seeding, use existing topsoil stockpile as specified in Section 02111. Provide additional imported topsoil if required at no extra cost and as specified under Section 02490.
6. **Wooden Pegs:** 17 mm x 17 mm x 200 mm.

PART 3 - EXECUTION

3.1 Application of Fertilizer

1. Apply fertilizer before sodding.
2. Spread fertilizer with mechanical spreaders over entire area of topsoil at rate of 16 kg (100 m²) or area.
3. Mix fertilizer thoroughly into upper 50 mm of topsoil.

3.2 Finish Grading

1. Fine grade entire topsoil area to contours and elevations. Eliminate rough spots and low areas to ensure positive drainage.
2. Roll topsoil with 50 kg. roller, minimum 900 mm wide to compact and retain surface.
3. Leave surface smooth, uniform, firm against deep foot printing, with a fine loose texture.

3.3 Laying of Sod

1. Obtain approval of topsoil grade and depth before starting sodding. Provide documentation that correct topsoil sub grade material has been installed.

2. Lay sod during growing season. Sodding during dry summer period, at freezing temperatures or over frozen soil is not acceptable.
3. Lay sod in rows, perpendicular to slope, smooth and even with adjoining areas, and with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with a sharp knife.
4. Provide close contact between sod and soil by means of light roller. Heavy rolling to correct irregularities in grade is not permitted.
5. Water immediately after sod laying to obtain moisture penetration through sod into top 100 mm of topsoil.
6. Provide adequate protection of sodded areas against erosion and mechanical damage. Remove protection after lawn areas have been accepted.
7. For slopes greater than 3:1 lay sod sections at right angles to slopes and secure with wooden pegs. Place 6 pegs per m², 100 mm below top edge and to prevent shifting of sod and drive pegs flush with top of sod soil.
8. Lay pieces of sod in turf stone apertures.

3.4 Maintenance

1. Ensure maintenance equipment is suitable to Consultant.
2. Water sodded areas in sufficient quantities and at required frequency to maintain sub-soil immediately under sod continuously moist for depth of 75 to 100 mm.
3. Cut grass first time when it reaches height of 40 to 50 mm. Remove clippings which will smother grassed areas.
4. Mow grass once a week (every seventh day) during the growing season at a height of 60 mm.
5. Trim grass edges around planting beds, building walls, light standards, signs, trees, etc., in neat lines as to original layout.
6. Keep sodded areas clean, pick up all debris, papers, excess construction materials or similar materials from all sodded areas and remove from site.
7. Apply herbicide when broad-leaf weeds start developing in competition with grass. Apply herbicide in accordance with manufacturer's instructions when winds are less than 10 km/h, when air temperature is above 10 deg. C.
8. Beginning in early April, fertilize sodded areas with fertilizer for four (4) successive months with a complete slow release fertilizer. Formulation ratio 20-10-10, brand name fertilizer at a rate of 300 lbs/acre.

3.5 Acceptance

1. It is the Contractors responsibility to maintain the sod in good condition until accepted.
2. It is the Contractors responsibility for any temporary fencing required to prevent foot traffic on all new and restored sod.
3. Sodded areas will be accepted at final inspection provided that:
 - .1 Sodded areas are properly established.
 - .2 Sod is free of bare and dead spots and without weeds.
 - .3 No surface soil is visible when grass has been cut to height of 45 mm.
 - .4 Sodded areas have been cut twice.
4. Lawns sodded in fall will be accepted in following spring one (1) month after start of growing season provided acceptance conditions are fulfilled.
5. Replace any deteriorated sod with new sod at the direction of the Consultant.
6. A site meeting will be scheduled by the General Contractor at least six weeks following installation to demonstrate to the Owner that roots have established before releasing the final amounts as determined by the Consultant.

End of Section

PART 1 - GENERAL

1.1 Source Quality Control

1. The work of the following sections must be performed by only one subcontractor referred to as the landscape sub-contractor.
Section 02260 Topsoil and Finish Grading
Section 02487 Sodding
Section 02490 Trees, Shrubs and Groundcovers
2. Obtain approval of plant material at source.
3. Notify consultant of source of material at least seven days in advance of shipment. No work under this section is to proceed without approval.
4. Acceptance of plant material at its source does not prevent rejection on site prior to or after planting operations.
5. Imported plant material must be accompanied with necessary permits and import licenses. Conform to Federal and Provincial regulations.

1.2 Shipment and Pre-Planting Care

1. Coordinate shipping of plants and excavation of holes to ensure minimum time lapse between digging and planting.
2. Tie branches of trees and shrubs securely and protect plant material against abrasion, exposure and extreme temperature change during transit. Avoid binding of planting stock with rope or wire which would damage bark, break branches or destroy natural shape of plant. Give full support to root ball of large trees during lifting.
3. Cover plant foliage with tarpaulin, and protect bare roots by means of dampened straw, peat moss, saw dust or other acceptable material to prevent loss of moisture during transit and storage.
4. Remove broken and damaged roots with sharp pruning shears.
5. Keep roots moist and protected from sun and wind. Heel-in trees and shrubs, which cannot be planted immediately, in shaded areas and water well.

1.3 Guarantee

1. The contractor hereby warrants that plant material as itemized on plant list will remain free of defects for one year.
2. End-of-Warranty inspection will be conducted.

1.4 Replacements

1. During warranty period, remove from site any plant material that has died or failed to grow satisfactorily as determined by consultant.
2. Replace plant material as soon as it is horticulturally acceptable.
3. Extend warranty on replacement plant material for a period equal to the original warranty period.
4. Continue such replacement and warranty until plant material is acceptable.

PART 2 - PRODUCTS

2.1 Materials

1. Water: potable and free of minerals, which may be detrimental to plant growth.
2. Stakes: T-bar steel stakes 50 x 50 x 6 x 2440 mm, wood 50 x 50 x 2400 mm.
3. Accessories: factory galvanized, cables, wire tighteners.
4. Guy wires: steel wire strand to CSA G4-M1977 at the following sizes:
 - .1 Shrubs and trees under 77 mm caliper use 2.4 mm wire.
 - .2 Trees 75 to 150 mm caliper use 3 mm wire.
5. Tree rings: fabricated from 3 mm galvanized wire encased in two ply reinforced 12 mm diameter rubber garden hose or equivalent.
6. Root ball burlap: 150 g Hessian burlap.
7. Wire baskets: to be ungalvanized metal.
8. Mulch: Submit samples prior to shipping to site:
 - .1 Shredded bark mulch.
9. Topsoil:
 - .1 For tree pits, planters, and shrub beds to be imported triple mix.
10. Antidesiccant: wax like emulsion to provide film over plant surfaces reducing evaporation but permeable enough to permit transpiration.

2.2 Plant Material

1. Conform to the horticultural standards of the Canadian Nursery Trades Associations with respect to grading and quality. Supplied in strict accordance with Plant List.
2. All plants shall be No. 1 Grade, nursery grown, under proper cultural practices with respect to fertile soil, ample spacing, regular cultivation, weed, pest control, adequate moisture and pruning, in accordance with good horticultural practices as advocated by the Canadian Nursery Trades Association. All such plants shall have been transplanted and/or root pruned regularly, but not later than nine (9) months prior to arrival on the site. The Contractor shall submit sources of plant material, in writing, if so requested by the Consultant.
3. Additional plant material qualifications:
 - .1 Plant material obtained from areas with milder climatic conditions from those of site acceptable only when moved to site prior to the breaking of buds in their original location and heeled-in, in a protected area until conditions suitable for planting.
 - .2 Use trees and shrubs with strong fibrous root system free of disease, insects, defects of injuries and structurally sound. Use trees with straight trunks, well and characteristically branches for species. Plants must have been root pruned regularly, but not later than one growing season prior to arrival on site.
 - .3 Cold storage: written approval from the consultant required for use of plant material which has been held in cold storage.
 - .4 Container grown stock: acceptable if containers large enough for root development. Trees and shrubs must have been grown in container for minimum of one growing season but not longer than two. Root systems must be able to “hold” soil when removed from container. Plants that have become root bound are not acceptable. Container stock must have been fertilized with slow releasing fertilizer.
 - .5 Balled and burlapped: coniferous and broad-leaved evergreens over 500 mm tall must be dug with soil ball. Deciduous trees in excess of 3 m height must have been dug with large ball. Root balls must include 75% of fibrous and feeder root system. Secure root balls with burlap and heavy twine, rope or wire basket.
 - .6 Collected plant material: will not be permitted.
 - .7 Substitutions to plant material as indicated on planting plan not permitted unless written approval has been obtained as to type, variety and size. Plant substitutions must be of similar species and or equal size as those originally specified. Give timely notice, in writing, to the Consultant when applying for substitutions.

PART 3 - EXECUTION

3.1 Workmanship

1. Stake out location of trees and planting beds as per planting plan. Obtain approval prior to excavating.
2. Apply antidesiccant in accordance with material manufacturer's instructions.
3. Coordinate operations. Keep sit clean and planting holes drained. Immediately remove soil or debris spilled on pavement.

3.2 Planting Time

1. Plant deciduous plant material during dormant period before buds have broken. Plant material noted for spring planting only, must be planted in dormant period.
2. Plant material imported from a region with warmer climate conditions may only be planted in early spring.
3. When permission has been obtained to plant deciduous plant material after buds have broken, spray plants with antidesiccant to slow down transpiration prior to transplanting.
4. Plant evergreens in spring before bud break. Apply antidesiccant to evergreens before digging.
5. When permission has been obtained, trees, shrubs and ground covers growing in containers may be planted throughout growing season.
6. Plant only under conditions that are conducive to health and physical conditions of plants.
7. Provide planting schedule. Extending planting operations over long period using limited crew will not be acceptable.

3.3 Excavation

1. Shrubs: excavate planting beds 450 mm deep and the full extend of bed areas as shown on plans. Dispose of excavated material off site.
2. Provide drainage for planting holes in heavy soil if natural drainage does not exist. Have method approved.
3. Protect bottom of excavation against freezing.
4. Remove water which enters excavations prior to planting. Ensure source of water is not ground water.

3.4 Planting

1. Loosen bottom of planting hole to depth of 150 to 200 mm.

2. Plant trees and shrubs vertically with roots placed straight out in hole. Orient plant material to give best appearance in relation to roads and walks.
3. With balled and burlapped root balls, loosen burlap and cut away minimum top 1/3 without disturbing root ball. Do not pull burlap or rope from under root ball. With container stock, remove entire container without disturbing root ball. Non-biodegradable wrappings must be removed.
4. Place plant material to depth equal to depth they were originally growing in nursery.
5. During planting of bare-rooted stock, first shake backfill of planting soil among the roots.
6. Tamp planting soil around root system in layers of 150 mm eliminating air voids. Frozen or saturated planting soil is unacceptable. When 2/3 of planting soil has been placed, fill hole with water. After water has completely penetrated into soil, complete backfilling.
7. Build 100 mm deep saucer around outer edge of hole to assist with maintenance watering.
8. When planting is complete, give surface of planting saucer dressing of organic 1:2:2 fertilizer at rate of 12 kg/100 m² for shrub beds or 40 to 50 g/mm of caliper for trees. Mix fertilizer thoroughly with top layer of planting soil and water in well.

3.5 Protective Wrapping

1. Protective wrapping installed by the nursery to prevent damage during shipping is to be removed upon planting to allow for inspection of the tree.

3.6 Tree Support

1. Tree support is shown on planting details.
2. Where guy wires are used close to pedestrian ways fasten flags to wires to make them clearly visible.

3.7 Pruning

1. Prune trees and shrubs after planting, as directed, to compensate for loss of roots suffered during transplanting. Postpone pruning, of those trees where heavy bleeding may occur, until in full leaf. Employ clean sharp tools and make cuts flush with main branch, smooth dead and injured branches and branches that rub causing damage to bark. Trim out crown of trees and shrubs without changing their natural shape. Do not damage lead branches or remove smaller twigs along main branches.

3.8 Mulching

1. Obtain approval of planting beds before mulching material is applied. Loosen soil in planting beds and pits and remove debris and weeds. Spread mulch to minimum

thickness of 50 mm. Mulch material susceptible to blowing must be moistened and mixed with topsoil before applying. When mulching is placed in fall, place immediately after planting. When mulch is placed in spring, wait until soil has warmed up.

3.9 Maintenance Before Acceptance

1. Perform following maintenance operations from time of planting to acceptance by Consultant:
 - .1 Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion.
 - .1 For evergreen plant material, water thoroughly in late fall prior to freeze-up to saturate soil around root system.
 - .2 Remove weeds monthly.
 - .3 Replace or respread damaged, missing or disturbed mulch.
 - .4 For non-mulched areas, cultivate as required to keep top layer of soil friable.
 - .5 Apply pesticides in accordance with Federal, Provincial and Municipal regulations as and when required to control insects, fungus and disease. Obtain product approval from Consultant prior to application.
 - .6 Remove dead or broken branches from plant material.
 - .7 Keep trunk protection and guy wires in proper repair and adjustment.
 - .8 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.
 - .9 Be responsible for protection of all planted areas, until all project work has been completed, approved and accepted.

3.10 Acceptance

1. Plant material will be accepted no sooner than the date at which the project is declared fit for occupancy provided that the following criteria are met:
2. Plant material has been planted for 90 days, exhibits healthy growing condition and is free from disease, insects and fungal organisms.
3. Plant material installed less than 90 days prior to frost will be accepted in following spring, 30 days after start of growing season provided that acceptance conditions are fulfilled.
4. All plant material will be inspected prior to acceptance. All plants must be in a healthy, vigorous, growing condition at time of inspection. All planting beds and tree pits shall be mulched, free of weeds, leaves, broken branches and debris, and in a neat and tidy condition.

End of Section

(HD)PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

1. Site Grading: Section 02210
2. Excavation, Backfilling and Rough Grading: Section 02220
3. Cast-in-Place Concrete: concrete curbs refer to structural drawings

1.2 Extended Warranty:

1. Submit a warranty for asphalt paving installation, covering materials and labour and the repair or replacement of defective work, but for two (2) years total.

PART 2 - PRODUCTS

2.1 Materials

1. **Sub-Base:** Generally, use Fill type "4" where required to reach design elevations.
2. **Base:** 50 mm and 19 mm crusher run limestone.
3. **Heavy Duty (HD) Pavement for Parking and Driveways:** Hot mix, hot laid asphaltic concrete HL8 and HL3, mixture conforming to O.P.S.S. #1150.05.
4. **Medium Duty (MD) Pavement for Playground and Walkways:** Hot mix, hot laid asphaltic concrete HL8 and HL3, mixtures conforming to O.P.S.S. #1150.05.
5. **Joint Painting Material:** SS-1 emulsion in accordance with O.P.S.S. #1103.05.

PART 3 - EXECUTION

3.1 Preparation

1. Regard locations and instructions on drawings. Report any discrepancies or questions to the Consultant prior to proceeding with the work. In particular pay attention to the exact delineation of all edges of pavement and types of pavement;
2. Set out work in accordance with lines and levels shown on Drawings. Maintain such lines and levels through duration of work. Ensure positive drainage toward catch basins is maintained in all areas.
3. Compact sub-grade to a minimum of 98% Standard Proctor density.
4. Paint exposed edge of asphaltic joints, edge of manhole and catchbasin frames, curbs and similar items with SS-1 emulsion.

3.2 Installation

1. Inspect site grades prior to installation. Review the precise grade requirements required on the grading plan. Review with the Consultant prior to installation if any conditions exist that may cause deviations from grades shown on Drawings. Coordinate catchbasin elevations with those shown on Mechanical site plan.

2. Pavement Section:

.1 Heavy Duty:

- minimum 400 mm compacted thickness of 50 mm crusher run limestone compacted to 100% Standard Proctor Maximum Dry Density (SPMDD), ASTM-D698 .
- 150 mm compacted thickness Base course of 19 mm crusher run limestone compacted to 100% SPMDD.
- 80 mm compacted thickness of granular asphalt HL8.
- 40 mm compacted thickness of granular asphalt HL3.

.2 Medium Duty:

- 300 mm compacted thickness of 50 mm crusher run limestone Sub-Base compacted to 100% Standard Proctor Maximum Dry Density (SPMDD), ASTM-D698.
- 150 mm compacted thickness Base course of 19 mm crusher run limestone compacted to 100% SPMDD.
- 40 mm compacted thickness of granular asphalt HL8.
- 30 mm compacted thickness of granular asphalt HL3.

3. Placing Granular Materials:

- .1 Exercise due care at all times to prevent granular materials from being contaminated by clay or other types of deleterious materials.
- .2 Place materials immediately after sub-grade is inspected by the Architect and as follows:
 - .1 To required width and thickness indicated on Drawings in layers not exceeding 100 mm compacted thickness crusher run limestone.
 - .2 Grade each layer and compact to a minimum 100% standard Proctor density to a smoother surface conforming to required cross-section.
- .3 Finished surface of granular material must not deviate more than 10 mm from designed grade.

4. Placing Asphaltic Pavement:

- .1 Obtain Consultant's inspection of compacted granular base before commencing asphalt paving.
- .2 Air temperature during placing of mixture must be minimum 7 deg. C and rising. Temperature of mixture when spread must be not less than 120 deg. C nor more than 150 deg. C. Do not increase temperature of mixture to offset long distance hauling.
- .3 Compact asphaltic mixture as soon as it can bear roller without undue displacement and hairline cracking and continue until all roller marks are eliminated. Speed of roller must at all times be slow enough to avoid displacement

of mixture. Keep roller wheels slightly moistened by water to prevent adhesion of mixture. Excess water will not be permitted. Compact mixture with hot tampers in locations that are not easily accessible to machine roller.

.4 Rolling Procedure:

- .1 Initial and final rolling must be accomplished using self-propelled Class "B" roller.
- .2 Intermediate rolling must be carried out using self-propelled Class "C" roller or "D" roller. Intermediate roller must follow breakdown roller as closely as possible.

.5 Upon completion of compaction each pavement course must be:

- .1 Smooth and true to crown and grade with variation not more than 6 mm from thickness shown on Drawing. Do not place any asphaltic course less than 25 mm thick nor more than 75 mm thick.
- .2 Free from depressions exceeding 3 mm as measured with 3 m straight edge paralleling centre line of driveways/aisles.
- .3 Compacted to a density not less than 97% Marshall.

5. Joints:

- .1 Cut back bituminous course to its full depth in straight or curved lines as required to expose fresh, straight, vertical surface. Remove broken and loose material.
- .2 Asphalt must be placed in such a manner that joint must not be allowed to cool before adjacent asphalt course is applied.
- .3 Where paving is comprised of two or more courses, joints must overlap by not less than 600 mm.
- .4 Carefully place and compact hot asphaltic material against joints. Correct any unsatisfactory joint before proceeding with work.
- .5 Feathering of joints will not be permitted.

3.3 Inspection & Testing

- 1. Refer to Section 01005.
- 2. Field inspections during installation, and core samples of all asphalt areas will be taken as part of Inspection and Testing. If tests show asphalt to be substandard to that specified, all asphalt shall be removed and replaced at the Contractor's expense. Cash credits will not be accepted for work which does not fully comply with drawings and specifications.

3.4 Certification of Grades

- 1. The Contractor is required to provide as-constructed elevations of the parking area to verify that the parking lot has been constructed in accordance with the contract drawings.

3.5 Pavement Markings

1. Parking Spaces:

- .1 Lay out lines as indicated on drawings and apply 100mm yellow - wide for parking, use mechanical application equipment.
- .2 End limit of each line to have clean, sharp 90° corners with no over spray fogging.
- .3 Thickness of paint application to be consistent throughout.
- .4 Under-sprayed lines shall be repainted.

2. Handicapped Symbols, as indicated on the Drawings, and as follows:

- .1 1200mm x 1200mm- White symbol in blue box.

3. Emergency Fire Route Markings:

- .1 Lay out lines as indicated on drawings and apply.

End of Section

PART 1 - GENERAL

1.1 General Requirements

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

1.2 Scope of Work

1. The work specified under this Section includes all labour, materials and equipment necessary for the complete repair and supply, installation and erection of the following:
 - .1 Chain link fence, all posts, top posts and foundations;
 - .2 Brace Units;
 - .3 Fence gates.

1.3 Description

1. Fencing shall be prepared and installed in accordance with the manufacturer's instructions and according to the details and in the locations shown on the Drawings.

1.4 Qualifications

1. Welding shall be undertaken by Fabricators fully approved by the Canadian Welding Bureau to qualification requirements of CSA W 47.1-1973.

1.5 Delivery, Storage and Handling

1. Provide adequate and suitable facilities for storage and protection of fencing and be responsible for any loss of, or damage to, when handling and delivering.

1.6 Shop Drawings

1. Submit Shop Drawings and/or Catalogue Illustrations in accordance with Section 01340.

PART 2 - PRODUCTS

2.1 Materials

1. Fencing: chain-link fencing fabric, posts, hardware, etc. to be supplied from one manufacturer as a complete, co-ordinated system. **Black vinyl coated**. Typical all members.
 - .1 Acceptable material: Frost Fence or equal.
2. Concrete mixes and materials:
 - .1 To CAN3-A23.1-M77.
 - .2 Compressive Strength: 20 Mpa minimum at 28 days.

- .3 Footings: 250 mm minimum diameter - 1200 mm minimum depth at line posts, 1500 mm minimum depth at terminal or gate posts.
- 3. Chain-link fence fabric: to CGSB/CAN2-138.1-M80.
 - .1 Woven steel wire fabric as follows:
 - .1 Mesh Size: 38 mm x 38 mm
 - .2 Wire Gauge: 9 gauge
 - .3 Top and Bottom Selvage: "Twisted and Knuckled" (TK)
 - .4 Height of Fabric: Refer to drawings height and for locations.
 - .2 Wire to be treated and finished as follows:
 - .1 Black Vinyl
- 4. **BLACK** Posts and rails: to CGSB/CAN2-138.2-M80+Amdt-June-82, galvanized steel pipe to ASTM A120 Schedule 40. Pipe sizes as follows:
 - .1 Terminal, Corner and Gate Posts: 89 mm (3-1/2 in) diameter.
 - .2 Line Posts: 60 mm (2-1/2 in) diameter.
 - .3 Top Rail, Gate Frames, Brace Rails, 43 mm (1-11/16 in) diameter.
 - .4 Bottom Rail: 43 mm (1-11/16 in) diameter.
- 5. Tie wire fasteners: single strand, vinyl coated steel wire conforming to requirements of fence fabric, 9 gauge.
- 6. Tension bar: 5 x 20 mm minimum size galvanized steel black.
- 7. Tension bar bands: 3 x 20 mm minimum size galvanized steel or 5 x 20 mm minimum size aluminum.
- 8. Fittings and hardware: cast aluminum alloy, galvanized steel or malleable or ductile cast iron. Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail (line posts). Turnbuckles to be drop forged. Use black painted or vinyl coated fittings at all locations.
- 9. Zinc-Rich Pigmented Paint: to CGSB 1-GP-178Ma: Black.

2.2 Finishes

- 1. Galvanizing:
 - .1 For chain-link fabric: to CAN/CGSB-138.1-M80 Grade 2.
 - .2 For pipe: 550 g/m2 minimum to ASTM A90-81.
 - .3 For other fittings: to CSA G164-M1981.

2.3 Gates

- 1. Swing Gates: 43 mm (1-11/16 in): Schedule 40 pipe for frame, welded construction to produce rigid frame. Provide gate hardware including latch mechanism to take padlock by others. Provide centre ground stay and receptacle for pairs of gates. All gates to be industrial quality, galvanized after fabrication, vinyl coated.

2.4 Fabrication

1. Wire fabric shall be woven into 38 mm mesh with top of fabric barbed and bottom knuckled. Fabric shall be hot-dip galvanized after weaving. Black vinyl coated.
2. All posts to be complete with necessary fittings and hardware.
3. Gate frames and braces shall be electrically welded at all joints and hot-dip galvanized after welding, and complete with malleable iron hinges, latch and latch catch.
4. Gate latches are to be designed such that padlock can be attached and operated from either side of gate.
5. Double gates are to have centre rest with drop bolt for closed position and chain hook to hold gates open.

PART 3 - EXECUTION

3.1 Erection

1. Line posts shall be spaced at 3,000 mm centres for fences 1,200 mm high and over, unless specifically indicated on drawings. Foundations for fence posts shall be 300 mm x 300 mm concrete, 1,200 mm deep below the lowest adjoining grade, with smooth tops domed above grade to shed water.
2. All terminal posts for fence to be horizontally braced with brace unit extending from terminal post to adjacent line post. Corner posts shall have two (2) brace units.
3. All posts shall be placed in a vertical plumb position and set accurately to line shown on Drawings.
4. The space between the ground surface and the bottom of the fabric shall not be less than 40 mm and not more than 80 mm.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Cast-In-Place Concrete:
2. Structural Metal Framing
4. Miscellaneous Metal Fabrication: Section 05500
5. Air Vapour Barrier Membrane: Section 07112
Note: in order to maintain continuity and quality control, the supply and installation of the full project scope of vapour barrier membrane is to be carried by a single trade.
6. Building Insulation: Section 07212
7. Mix Specified for Filling Blocks:

1.2 Reference Standards

1. CSA-S304.1-04 Design of Masonry Structures
2. CSA- A370-04 (R2009) Connectors to Masonry.
3. CAN/CSA-A371-04 (R2009) Masonry Construction for Buildings.
4. CSA A179-04 (R2009) Mortar and Grout for Unit Masonry
5. CSA-A82-06 Fired Masonry Brick From Clay or Shale
6. CSA A165 Series-04 CSA Standards for Concrete Masonry Units.
7. CSA G30.18-09 Carbon Steel Bars for Concrete Reinforcement
8. CAN/CSA-A3000-08 Cementitious Materials Compendium
9. ASTM A951/A951M-06 Standard Specification for Steel Wire for Masonry Joint Reinforcement
10. ASTM C216-07a Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
11. ASTM C568-08a Standard Specification for Limestone Dimension Stone
12. ASTM A1064/A1064 Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
13. ASTM C331-05 Standard Specification for Lightweight Aggregates for Concrete Masonry Units
14. ASTM A153/A153M-09 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

1.3 Source Quality Control

1. Submit laboratory test reports certifying compliance of masonry units (and mortar ingredients) with specification requirements.
2. For clay units, in addition to requirements set out in referenced CSA and ASTM Standards include data indicating initial rate of absorption for units proposed for use.
3. All masonry: mortar and grout is to be tested in accordance with CSA-S304.

1.4 Product Delivery, Storage and Handling

1. Ensure that materials are delivered to job site in dry condition.
2. Except where wetting of bricks is specified, keep materials dry until use.
3. Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.
4. Store cement under cover. Keep dry and unfrozen.
5. Pile sand on platforms. Exclude foreign matter.
6. Materials stacked on floors of building shall not exceed structural design loads.

1.5 Cold Weather Requirements

1. Comply with Clause 6.7.2 of CSA-A371.

1.6 Hot Weather Requirements

1. Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

1.7 Protection

1. Until completed and protected by flashings or other permanent construction, keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain.
2. Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.
3. Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.
4. When air temperature has dropped below 0 degrees C (eg. Overnight), ensure that materials are above freezing and free from ice when installed.

5. Prevent work from freezing for at least 48 hours by enclosure, artificial heat, or other acceptable method.
6. Provide adequate bracing to walls during erection to prevent damage due to winds or other lateral loads.
7. Make good any damage to masonry work until completion of the work.
8. Build masonry in enclosures heated by approved smokeless means, when temperature remains below 0 degrees C. All materials shall be above 4 degrees when installed.
9. Demolish and replace masonry work damaged by freezing.
10. Supplement CSA-A371 as follows:
 - .1 Maintain temperature of mortar between 5° C and 50° C until used.

1.8 Job Mock-up

1. Construct mock-up panel of exterior and interior masonry wall construction 2 m x 2 m showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, coursing, mortar, application of membrane air vapour barrier, insulation and workmanship. Mock-up may be part of construction.

1.9 Submittals

1. Make submittals in accordance with Section 01340.
2. Submit samples of:
 - .1 Masonry units (each type).
 - .2 Veneer anchors.
 - .3 Masonry reinforcement.
 - .4 Mortar Colours.
 - .5 Each masonry accessory.

PART 2 - PRODUCTS

2.1 Materials

1. Concrete Masonry Units:

Must be "Bubble Cure" or autoclave process, modular metric size conforming to CSA Standard A165 series.

Normal Weight - H/20/A/M, S/20/A/M.

Lightweight - H/20/C/M, S/20/C/M.

Use normal weight in below ground floor elevation. Use light weight for all above grade walls. All exposed corners must have bullnose units. All blocks be uniform in color, shade and texture. Special shapes as required.

2. Acoustical Concrete Masonry Units:

N/A

3. Architectural Concrete Masonry Units:

N/A

4. Manufactured Stone:

N/A

5. Clay Brick Masonry Units:

.1 Clay Brick **Type-1**, Ballycroy Architectural Series 2022 by Canada Brick, Metric Modular passing Test Methods specified in CSA-A82. Final selection to be confirmed by Architect.

.2 Clay Brick **Type-2**, Mahogany Velour Ironspot, by Canada Brick, Metric Modular passing Test Methods specified in CSA-A82. Final selection to be confirmed by Architect.

Acceptable Similar Alternate by: Brampton Brick, Thames Valley
Brick must be colour thru and not a surface matching colour.

Architectural Stone Units:

.1 Arch. Masonry **Type-1**, Olive Renaissance by Arriscraft – 190mm x 390mm x 90mm, arranged in stack bond, see elevation drawing. Final selection to be confirmed by Architect.

Acceptable Similar Alternate by: Shouldice Designer Stone.

6. Precast Stone Caps:

.1 N/A

7. Portland Cement:

.1 Type 10, in accordance with CSA A3001.

8. Masonry Cement:

.1 Type “S” and shall comply with CSA A3002.

9. Hydrated Lime:

.1 Type “S”, in accordance with CSA A179.

10. Aggregate:

.1 Fine grain aggregate, grading in accordance with CSA A179. When 6mm joints are specified, grain shall pass through a 1.18 mm sieve.

11. Water:

- .1 Ensure that water contains no salts which may cause efflorescence.

12. Horizontal Masonry Reinforcing:

Welded truss type or ladder type, as specified from wire to ASTM A951, hot dipped galvanized after fabrication to ASTM A153-05, Class B2, minimum coating 457 G/m2, wire size 4.76 mm diameter. Reinforcing as per the following:

- Single wythe walls Dur-O-Wal DW 100;
- Double wythe walls (up to 390 in width) Dur-O-Wal DW 120;
- Double wythe walls (greater than 390) Dur-O-Wal DW 220;
- Cavity Walls Blok-Lok- Blok truss II - BL37 to accommodate 95 mm cavity with 64 mm thick insulation. Use Blok-truss BL 30- or DW 100 if using Ferro slotted block ties. Similar reinforcing by Dur-O-Wal, Blok-Lok, and Hohmann & Barnard Inc. is acceptable.

13. Reinforcing Bars: billet steel to grade 400, deformed bars to CSA-G30.18.

14. Brick Ties:

- .1 Hook type box ties, 4.76 mm galvanized steel wire, to be used in conjunction with Block-Lok Block-Truss II BL 37 at concrete block back-up wall.
- .2 Ferro Slotted Rap-Ties 16 gauge sheet metal, hot tipped galvanized, with 4.76 mm hot tipped galvanized V-Ties – Use at concrete wall back-up, at wood parapet and where other ties are not practical.
- .3 Ferro slotted block ties, 16 gauge sheet metal, hot-dipped galvanized, with 4.76mm hot-dipped galvanized V-ties to accommodate 95 mm cavity with 64 mm thick insulation. To be used in conjunction with horizontal reinforcing as specified under paragraph 2.10.

15. Dampproof Course: Modified bitumen flashing membrane, Blueskin SA manufactured by Bakor, or approved equal.

16. Lateral Support Anchors:

.1 Vertical:

- .1 At intersection and abutting load bearing walls, use prefabricated corners and tees to match horizontal reinforcing.
- .2 At intersection of non-load bearing walls with load bearing or non-load bearing walls, use corrugated galvanized ties.
- .3 At wood parapet and similar conditions, use slotted Rap ties by Fero. Ensure ties extend a minimum of 50 mm into the brick or block outer wythe.
- .4 At connection with existing masonry, use joint stabilization anchors by Dur-O-Wall D/A 2200.
- .5 At control joints, use joint stabilization anchors by DUR-O-WALL D/A 2200.
- .6 At connection with steel structure use weld-on column assembly D/A 709 and D/A 701 by DUR-O-WALL. Supply welded anchor to steel trade for installation.

- .2 **Horizontal:** At underside of building structure use steel angles on both sides of partitions as specified in Section 05121 and detailed on structural drawings. Where

not practical, use D/A 2200 joint stabilization anchors by DUR-O-WALL. Fasten to structure. Install at 800 mm O.C.

17. **Bolts and Anchors:** To CSA-A370.

18. **Natural Mortar:**

- .1 **Generally:** Use materials only as specified in CSA A179. Ensure that weather and aggregate used in mortar, other than in walls buried in earth, will not cause efflorescence.
- .2 **Mixes:** Mix mortars as specified in CSA A179 using the Proportion Specification.
- .3 **Mortar Types:**
 - .1 For masonry walls in contact with earth and bedding for bearing plates and lintels: Mortar Type “S”.
 - .2 For load-bearing walls: Mortar Type “S”.
 - .3 For brick: Mortar Type “N” (1:1:6) premixed “Betomix 1-1-6”, portland cement, “S” type, hydrated lime as supplied by Daubois Inc., Jiffy Mortar Systems; Maxi-Mix 1-1-6 silo mortar; or approved equivalent. Mix on site with sand, water, and colour pigment.
 - .4 For all other masonry walls, use regular Type “N” mortar.
- .4 **Grout:** To CSA A179 Table 5.

19. **Colour Pigments:** Pigments constituted of ground coloured natural aggregates or metallic oxide pigments, color by architect, the ratio of coloring agent/density of portland/lime shall not exceed 10%.

20. **Mortar Dropping Control Device:** “Mor-Control” manufactured by Dur-O-Wal or Mortar-Net.

21. **Weepholes:** 90 mm x 90 mm x 10 mm purpose made PVC, designed to drain cavities to prevent insects from entering. Colour to be chosen by Architect from manufacturer’s full range.

22. Metal flashing at top of foundation wall and at exterior lintels: 24 gauge prefinished sheet metal with Stelco or Dofasco series 8000 finish – color to match brick. With self adhering membrane flashing at underside (Blue Skin SA).

PART 3 - EXECUTION

3.1 Workmanship

- 1. Build masonry plumb, level, and true to line, with joints in proper alignment.
- 2. Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
- 3. Set out and build masonry work to the respective dimensions called for on the drawings. Build and lay the block true to line, and level, align vertical joints. Keep angles, reveals, etc. square and plumb.
- 4. Assume complete responsibility for dimensions of this work.

5. Construct masonry fire rated assemblies in accordance with tested design specifications.
6. Make all joints uniform, in line, square and plumb, with mortar compressed to form joints as specified.
7. Course units to bring wall to required elevations using even, uniform, horizontal and vertical joints of maximum 10mm thickness. Horizontal joints brick soldier coursing to suit adjacent running bond.
8. Check and co-ordinate location of all anchors, connections and built-in items.
9. Bond units at intersection of walls by horizontal prefabricated “tee” or corner reinforcing units.
10. Lay each solid unit in full bed or mortar. Fill vertical joints. Slushing of joints not permitted.
11. Base course to be solid concrete masonry units laid in full mortar bed.
12. Lay each hollow unit in full bed or mortar for face shells. Butter vertical joints full. When laying closure units, butter vertical units already in place instead of units being placed.
13. Lay exposed masonry units using blocks having square, unbroken edges and corners.
14. Tolerances:
 - .1 Variation from mean plane: 6 mm when measured with 3000 mm straight edge.
 - .2 Variation from plumb: 6 mm on any vertical line up to 6000 mm high.
 - .3 Variation in wall opening sizes: 6 mm maximum.
 - .4 Variation of building lines from plan: in any bay or 6000 mm maximum – 12 mm or in 1200 mm or more, 20 mm.
15. Lay out masonry units carefully so as to run as often as possible in full and half unit dimensions. All exposed ends shall match the finish of the faces.
16. All units cut around pipes, ducts, openings, etc. shall be accurately and neatly cut with a power carborundum wheel, and remaining voids shall be slushed full with mortar.
17. Make joints flush and smooth on both sides excepts where they are to be exposed to view. When exposed to view, tool the joints concave, unless otherwise noted.
18. Lay and set up all units carefully so that both faces of the walls are true and even. Do not use chipped or cracked units where exposed to view, even where the defect would not impair strength or durability.
19. Take particular care to keep cavities, weep holes, vents and exposed faces of all units free of mortar.

3.2 Tolerances

1. Clause 6.2 of CAN3-A371 applies except as follows: Walls to receive thinset ceramic tile: plumb within 1:600.

3.3 Exposed Masonry

1. Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.

3.4 Jointing

1. Concave joints, allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, compressed, uniformly concave joints.
2. Raked joints, where split rib blocks are used, allow joints to set just enough to remove excess water, then rake joints uniformly to depth of rib and compress with square tool to provide smooth, compressed, raked joints of uniform depth.
3. Where joints are concealed in walls and where walls are to receive plaster, tile insulation, or other applied material, except paint or similar thin finish coating, strike flush.

3.5 Weepholes

1. Install weepers at regular intervals at both top and bottom of walls as indicated on Drawings. Ensure weepers are clear and unblocked mortar.

3.6 Joining of Work

1. Where necessary to temporarily stop horizontal runs of masonry, and in building corner, Step-back masonry diagonally to lowest course previously laid. Do not "tooth" new masonry. Fill in adjacent course before heights of stepped masonry reach 1200 mm.

3.7 Cutting

1. Cut out neatly for electrical switches, outlet boxes, and other recessed or built-in objects.
2. Make cuts straight, clean, and free from uneven edges. Use masonry saw where necessary.

3.8 Building-In

1. Build in items required to be built into masonry by other trades.
2. Prevent displacement of built-in items during construction. Check for plumbness, alignment, and correctness of position, as work progresses.
3. Brace door jambs to maintain plumbness. Fill door frame with concrete.

3.9 Wetting of Bricks

1. Except during winter, wet clay brick having an initial rate of absorption exceeding $1\text{g/min}/100\text{mm}^2$; wet to uniform degree of saturation, to 24 hours before laying, and do not lay until surface is dry.
2. Similarly, wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.

3.10 Support of Loads

1. Where concrete fill is used in lieu of solid units, use 20 MPa concrete to Section 03300.
2. Install building paper below voids to be filled with concrete; keep paper 25 mm back from faces of units.

3.11 Provision for Movement

1. Leave 5 mm space below shelf angles.
2. Leave 6 mm space and do not use wedges between tops of non-load bearing walls and partitions and structural elements.

3.12 Loose Steel Lintels

1. Install loose steel lintels. Centre over opening width.

3.13 Control Joints

1. Except as noted following, control joints required at maximum of 6000 mm o.c. in continuous walls having no openings, intersections or column locations. Refer to elevations for locations on exterior walls and advise Consultant of variances prior to executing the work. Control joints are not shown for clarity on the drawings for interior walls. If in doubt, request assistance from the Consultant.
2. At doorway locations, unless indicated otherwise on elevation drawings, use one side of doorway beyond lintel. Use building paper to prevent that end of lintel to bond.
3. Use standard block with concrete filled end core to form key. Line one side of core with building paper before filling core to prevent bonding. Complete vertical separation, full height and thickness of wall are required.
4. Stop masonry reinforcing at each side of the joints. Caulking specified in Section 07900.
5. At expansion joints in brick and veneer, install Rapid Expansion joint DA 2015, to leave vertical joint free of mortar to allow for horizontal expansion.

3.14 Horizontal Reinforcing

1. Horizontal reinforcing at 400 mm o.c. (every 2nd course), except solid walls greater than, or equal to 340 mm in width. At 340 mm, or greater, horizontal reinforcing at 200 mm o.c. (every course). Use prefabricated corners and tees at all intersecting load bearing walls.

3.15 Vertical Reinforcing

1. Install vertical reinforcing to size and spacing as shown on Drawings. Fill voids with 20MPa concrete.

3.16 Brick Ties

1. Install specified brick ties at maximum 800 mm horizontal and 400 mm vertical spacing.

3.17 Bonding

1. Walls of two or more widths: bond using metal ties in accordance with subsection 9.4 of CSA-A371.
2. Procedure approval by Architect.
3. In cavity walls, keep all cavity spaces free of mortar and debris by placing a wood strip on the ties. Retain strip on a wire line and pull up level and clean off droppings prior to placing next course of ties. Install mortar control device at 300 mm o.c. horizontally, in a staggered pattern so as to overlap each other on each side. Install in every 2nd course above foundation and shelf angles.

3.18 Sound and Fire Separation

1. All load bearing and non-load bearing partitions shall carry to the underside of structure above, except for allowing for deflection of structure.
2. All openings in partitions, even above ceilings shall be patched to maintain sound and fire separation.
3. In fire separations and sound separations, spaces between partition and structures to be firestopped or sound sealed under Section 07270.
4. Use U.L.C. labeled mortar for all patching in fire separations.

3.19 Dampproof Course Flashing

1. Install dampproof course flashing at ground floor elevation in all walls on foundations.

3.20 Testing

1. Masonry units to be tested in accordance with S304.1, Clause 15.1, for engineered masonry design, and in conformance with clause 15.1.2.
2. Mortar testing to be in accordance with S304.1, clause 15.2.
3. Grout testing to be in accordance with S304.1, clause 15.3.

3.21 Blockwork - General

1. Do not wet concrete block before laying.
2. Lay block with thicker end of face shell upward.

3. Lay interior block in running bond, concave tooled joints.
4. Use solid block or hollow block filled with concrete for top 2 courses under point bearing loads extending minimum 200 mm each side of bearing and where indicated.
5. Install special shaped units where indicated.
6. In block walls install continuous trussed wire reinforcement, as noted.
7. Where resilient base is indicated, tool the joints to within 100 mm of the floor. Cut joints flush behind the base.
8. Extend all walls/partitions to underside of steel/concrete deck unless shown otherwise on drawings and as required. Co-ordinate wall locations with structure above and prior to commencing work, advise Consultant of interference.
9. When masonry walls are not built at once, the ends of the walls are to be raked back at an angle, or terminated at a control joint. Toothing will not be permitted.

3.22 Mortar

1. Measure loose damp ingredients accurately by volume. Place water in mixer, add half volume of sand, add cement, add remainder of sand, add water for plasticity. Mix for at least four minutes. Keep mixer clean.
2. Incorporate colour into mixes in accordance with manufacturer's instructions.
3. Use clean mixer for coloured mortar.
4. Prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into a ball. Allow to stand for not less than 1 hour nor more than 2 hours then remix with sufficient to produce mortar of proper consistency for pointing.

3.23 Concrete Core Fill

1. All concrete block walls shall have vertical grout core fill each side of openings and where shown and as detailed on the drawings.
2. Core fill in walls shall extend from bottom bearing surface to underside of bond beams or structure.
3. Grout core fill shall be placed with a trunk or chute in maximum lifts 2000 mm. Compaction shall be by interior mechanical vibrator. All fill shall be placed in accordance with CSA A23.1.
4. Fill minimum ½ block core each side of frame from foundation to underside of lintels of all door openings over 1 metre wide.

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5. Provide inspection openings in base of walls to be grouted. Make good to match adjacent block work after inspection and approval by Engineer.

3.24 Reinforced Block Lintels

1. Install reinforced concrete block lintels at all openings where steel lintels are not indicated in accordance with structural details.
2. Install shoring and bracing as required to openings prior to placing lintel units and concrete fill.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Installation of anchors in concrete and masonry:	Section 04200
2. Structural Steel Framing:	
3. Steel Joist Framing:	
4. Metal Decking:	
5. Painting:	Section 09900

1.2 Scope

1. Provide all miscellaneous metal items except those listed above Under Article 1.1.

1.3 Reference Standards

1. ASTM A167-99(2009)	Standard Specification for Stainless and Heat-Resisting Chromium - Nickel Steel Plate, Sheet and Strip.
2. ASTM A325-09ae.1	Standard Specification for Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength.
3. ASTM A143/A143M-07	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
4. ASTM A307-07b	Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
5. ASTM A563-07a	Standard Specification for Carbon and Alloy Steel Nuts.
6. ASTM A780/A780M-09	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
7. CAN/CSA-S16-09	Design of Steel Structures.
8. CSA W59-03(R2008)	Welded Steel Construction (Metal Arc Welding).
9. CSA-G40.20-04/G40.21-04(R2009)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.
10. ASTM A123/A123M-09	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
11. CISC/CPMA 2-75	Canadian Institute of Steel Construction/Canadian Paint Manufacturers Association-A Quick Drying Primer for Use on Structural Steel.

12. CAN/CGSB-1.40-97	Anticorrosive Structural Steel Alkyd Primer.
13. ASTM A53/A53M-07	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

1.4 Shop Drawings

1. Submit shop drawings in accordance with Section 01340 prepared and stamped by a Professional Engineer licensed to design structures in the Province of Ontario.
2. Clearly indicate materials, core thickness, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.

PART 2 - PRODUCTS

2.1 Materials

1. Metals:
 - .1 **Steel sections and plates:** to CAN3 G40.21, Grade 350W for tubes and Grade 300W for plates and flat shapes.
 - .2 **Welding Materials:** to CSA W59.
 - .3 **Bolts and anchor bolts:** to ASTM A307, A325, and A563 as applicable.
 - .4 **Stainless Steel:** Type 302 or 304 alloy conforming to ASTM A167, No. 4 finish.
2. Primers, Coatings and Shop Painting
 - .1 **Interior Steel in Dry Areas:** Quick drying oil alkyd conforming to CISC/CPMA 2.75.
 - .2 **Exterior Steel, Interior Steel in Unheated Areas, Steel Embedded in Concrete:** Hot dip galvanized conforming to ASTM A123, minimum Z275 coating.
 - .3 **Galvanizing** of structural steel components and loose lintels: refer to Section 05120.
 - .4 **Galvanized Coating Touch-Up:** W.R. Meadows "Galvafruid" or Kerry Industries "Z.R.C." zinc rich coating or similar manufacturer containing minimum 90% zinc by weight.
 - .5 Apply one shop coat(s) of primer or coating as indicated above and according to manufacturer's recommendations. Do not prime aluminum, stainless steel or those components to be galvanized or encased in concrete.
 - .6 Use primer unadulterated, as provided by manufacturer. Paint on dry surfaces free from rust scale and grease. Do not paint when temperature is lower than 10 deg. Celsius and rising.
 - .7 Clean surfaces to be field welded; do not paint.
3. Fastenings
 - .1 Use nuts and bolts conforming to ASTM A307, A325, and A563 as applicable.
 - .1 For interior work, use cadmium-plated fastenings where other protection is not specified.

.2 For exterior work, use Type 300 or 400 stainless steel.

4. Anchors and Shims

.1 For exposed anchorage of aluminum, if applicable, use stainless steel and otherwise to match metal anchored. For non-exposed work, anchors and shims may be galvanized steel.

5. Pipe

.1 To ASTM A53, extra strong steel pipe for bollards.

6. Bituminous Paint

.1 Alkali-resisting, use to insulate contact between dissimilar metals.

2.2 Fabrication

1. Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
2. Weld all connections where possible, and bolt where not possible unless indicated otherwise on drawings.
3. Use self-tapping shake-proof countersunk flat headed screws on items required to be assembled by screws or as indicated.
4. Where possible, work to be fitted and shop assembled, ready for erection.
5. Exposed welds to be continuous for length of each joint. File or grind exposed welds smooth and flush.
6. Weld all stainless steel by the Argon Arc Process. Grind smooth and polish joints, crance-free, and flush without seams.

2.3 List of Miscellaneous Metal Fabrications

1. This Section includes, but is not limited to the following list. Note: **Galvanize all exterior items** and other items noted. Prime paint all interior items.
 - .1 Anchors, Bolts, Inserts, Sleeves for work in this Section.
 - .2 Shelf Brackets.
 - .3 Stair stringers, railings, handrails.
 - .4 Hangers and Supports (for work in this Section).
 - .5 Lintels (if not by Structural Steel).
 - .6 Bollards
 - .7 Roof ladder.
 - .9 Gate and posts

PART 3 - EXECUTION

3.1 General

1. Supply and install all miscellaneous metal work indicated on the Drawings and not indicated in work of other Sections in addition to items listed below.

3.2 Fabrication & Erection

1. Erect metal work square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
2. Insulate metals, where necessary, to prevent corrosion due to contact between dissimilar metals and between metals and masonry or plaster. Use bituminous paint, butyl tape, building paper or other approved means.
3. Provide suitable and acceptable means of anchorage, such as dowels, anchor clips, bar anchors, expansion bolts and shields, toggles.
4. Make field connections with items specified in Articles 2.1.4 and 2.1.5 or weld to CSA S16.
5. Hand items to be cast into concrete or built into masonry over to appropriate trades together with setting templates.
6. Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection.
7. Touch-up galvanized surfaces with zinc primer where burned by field welding. Spray or brush apply a minimum of three (3) coats of zinc-rich paint to achieve a dry film thickness of 8 mils. Apply a finish coat of aluminum paint to provide a colour blend with the surround galvanizing.

3.3 Wall Benches and Upper Shelf

1. N/A

3.4 Railings and Guards

1. Provide railings and handrails, as shown on Drawings.
2. Galvanize all exterior railings after fabrication.
3. Wall brackets, as shown, at 1200 mm o.c. maximum.
4. Set railing standards in concrete with heated liquid sulphur to fill hole. Remove overflow immediately.

3.5 Vanity Brackets

1. Angle steel frame, as shown on drawings - shop prime painted.

3.6 Wall Brackets and Hooks

1. As shown on Drawings - prime paint.

3.7 Bollards

1. Supply and install galvanized steel bollards as shown on Drawings. Bollards shall be 150 mm x 9.5 mm thick wall at 1200 mm high, seamless steel pipe. Install min. 1200 mm into a concrete foundation or as per detail. Fill bollard with 25 Mpa concrete and round top. Round top of footing also. For number of Bollards required - refer to Drawings.

3.8 Galvanized Steel

1. Galvanize steel members, fabrications, and assemblies after fabrication by the hot dip process in accordance with ASTM A123, minimum Z275 coating.
2. Galvanize bolts, nuts and washers and iron and steel hardware components in accordance with ASTM A123.
3. Safeguard products against steel embrittlement in conformance with ASTM A143.
4. Design features which may lead to difficulties during galvanizing shall be pointed out prior to dipping.
5. The composition of metal in the galvanizing bath shall be not less than 98.0% zinc.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Concrete Forming & Accessories: Refer to structural drawings
2. Commercial Steel Doors and Frames Section 08100

1.2 Source Quality Control

1. Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Administration Board.

PART 2 - PRODUCTS

2.1 Materials

1. **Wood Materials:** Material, straight, sawn square, true, dressed four (4) sides properly sized, shaped to correct dimensions from nominal sizes indicated or specified.
2. **Lumber: Use only grade marked lumber. Where left exposed, use best brand of lumber available.** Lumber and moisture content to conform to official grading rules of NLGA, for particular lumber and grade, and structurally conform to latest requirements of Ontario Building Code. Conform to Grading Standards, CSA Standard Softwood Lumber 2005. Moist content not greater than 19% at time of installation.
3. **Blocking, Cants, Bucks, Grounds and Nailing Strips:** Douglas fir Graded 122-C, construction or No. 2 Pine, pressure treated in accordance with CSA 080 Series 08.
4. **Plywood:** Douglas fir plywood to CSA 0121-08, good one side with waterproof adhesive.
5. **Rough Hardware:** Nails, screws, bolts, lag screws, anchors, special fastening devices and supports required for erection of all carpentry components. Use galvanized components where exposed to exterior atmosphere.

PART 3 - EXECUTION

3.1 General

1. Do all wood framing in accordance with the Ontario Building Code, Engineering Design in Wood and CSA 086 - 01.
2. Machine dressed work shall be slow fed using sharp cutters and finished members shall be free from drag, feathers, slivers or roughness of any kind.
3. Frame materials with tight joints rigidly held in place.
4. Design construction methods for expansion and contraction of the materials.
5. Erect work plumb, level, square and to required lines.

6. Be responsible for methods of construction for ensuring that materials are rigidly and securely attached and will not be loosened by the work of other trades.

3.2 Furring and Blocking

1. Supply and install furring and blocking, required.
2. Align and plumb faces of furring and blocking to tolerance of 1:600.

3.3 Rough Bucks, Nailers

1. Install wood bucks and nailers, as indicated, including wood bucks and linings around frames for doors and windows.
2. Except where indicated, otherwise, use material at least 38 mm thick secured with 9 mm bolts located within 300 mm from ends of members and uniformly spaced at 1200 mm between.
3. Countersink bolts where necessary to provide clearance for other work.

3.4 Roof Fascias, Cants, Nailers, Curbs

1. Install wood cants, fascia backing, nailers, curbs and other wood supports for roofing, sheet metal work, roof mounted equipment.
Refer to Section 07550 Modified Bituminous Roofing.
2. In reference to section 07550 Modified Bituminous Roofing, subsection 3.4 Carpentry and Section 07610 Sheet Metal Roofing: all wood blocking work related to roofing including but not limited to parapets, walls and curbs is by Section 06100 Rough Carpentry. The general contractor is responsible to turn over this work in a dry condition to roofing contractor for making watertight as part of roofing work. After acceptance, the roofing contractor is responsible to maintain water tightness.

3.5 Supports for Mechanical Units

1. Install wood blocking for prefabricated curbs for mechanical units to allow for a level installation on sloping roof.

3.6 Pressure Treated Wood

1. Use wood pressure treated in accordance with CSA 080 for all wood members in contact with exterior walls and roofs.
2. Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
3. Fasten each slat to steel frames with 2 screws at top, bottom and at diagonal bracing.

3.7 Installation of Hollow Metal Frames

1. Set frames plumb and square in their exact location and at correct elevation. Firmly block and brace to prevent shifting. Shim up where required to ensure proper alignment dimensions from finished floor to head of frame. Install temporary wood spreaders at mid-height.
2. Where pressed steel frames are installed in concrete walls, secure frames to concrete using lead expansion shields and anchor bolts through pipe sleeves. Perform drilling of concrete as required. Fill recessed bolt heads flush to frame face with approved metal filler and sand smooth.
3. Install fire rated door frames in accordance with requirements of National Fire Code Volume 4, produced by The National Fire Protection Association (NFPA 80).

3.8 General

1. Supply and install all other carpentry shown on drawings or as required for completion of work. Co-operate with other trades in installing items supplied by other sections, cut openings in woodwork when so required and make good disturbed surfaces.

End of Section

PART 1 - GENERAL

1.1 Section Includes

1. Section includes for provision of all labour, materials, equipment and services for new rough carpentry in accordance with Contract Documents.

1.2 Related Sections

1. Section 07510 Built Up Bituminous Roofing
2. Section 07620 Sheet Metal Flashing and Trim for Roofing
3. Section 07901 Joint Sealers for Roofing

1.3 References

1. CSA B111 / ASTM F1667 - Wire Nails, Spikes and Staples
2. ANSI/ASME B18.6.1 - Slotted and Recessed Wood Screws
3. ASTM A307-Carbon Steel Bolts & Studs
4. CSA O121 - Douglas Fir Plywood
5. CAN/CSA O141 – Softwood Lumber
6. CSA O151 – Canadian Softwood Plywood
7. CAN/CSA-080 Series - Wood Preservation
8. CAN/CSA-O325.0 – Construction Sheathing
9. Graded lumber must be in accordance with rules and regulations of the National Lumber Grades Authority (NLGA).

1.4 Operations

1. Do not interrupt or delay *Owner's* operations.
2. Perform operations, at times designated by the *Owner*, that will not adversely affect occupants of building and operations in and around site access and egress.

1.5 Protection

1. Provide perimeter barricades and tarpaulins, guardrails, overhead scaffolding and other necessary protection to ensure safety of occupants, public and site workers.
2. Temporarily protect interior spaces, where overhead work is proceeding, and provide dustproof and weatherproof partitions.

1.6 Shop Drawings

1. Submit shop drawings, stamped by a Professional Engineer, licensed in Province of Ontario, if members and securement are part of structural components.

1.7 Permits

1. If required, arrange and pay for all permits, notices and inspections necessary for the proper execution of work in this section.

1.8 Quality Assurance

1. Lumber shall be identified by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
2. Plywood shall be identified by grade mark in accordance with applicable CSA standards.

1.9 Lumber Requirements

1. Dimensions of lumber must conform to dressed sizes specified in CAN/CSA-0141. Dimensions specified and shown are nominal sizes.
2. Moisture content of lumber at time of installation must be S-DRY - maximum 19% moisture content.
3. Lumber must be sound and free of splits and deficiencies, which impair strength and durability.

1.10 Securement

1. Members shall be framed, anchored, fastened, tied and braced to provide necessary strength and rigidity.
2. All nails shall be long enough so that not less than half their required length penetrates into the second member.
3. Individual pieces must be secured with minimum of 2 fasteners at all corners.
4. Splitting of wood members shall be minimized by staggering nails in the direction of the grain and by keeping nails a minimum of 52 mm (2 in.) in from edges.

1.11 Waste Management and Disposal

1. Remove from site and dispose packaging materials at approved facilities.

PART 2 - PRODUCTS

2.1 Material

1. Wood Blocking: No.1 Exterior Grade, 52 x 52 mm (2 in. x 2 in.) 52 x 104 mm (2 x 4 in.), 52 x 152 mm (2 x 6 in.), 52 x 203 mm (2 x 8 in.), 52 x 254 mm (2 x 10 in.) and 52 x 305 mm (2 x 12 in.) and as noted on drawings/details.
2. Plywood Sheathing: 13 mm (1/2 in.) and 19 mm (3/4 in.), exterior grade, solid one side (G1S) unsanded, Veneer Grade B+. Moisture content of plywood shall not exceed 19% on a 'dry weight basis'.
3. Wood Cant: 75 x 75 mm (3 x 3 in.), No.1 Grade, Pressure Treated, exterior grade
4. Shims: Constructed from plywood sheathing or tapered wood blocking to provide minimum 10% slope to interior of roof surface, as indicated on drawings.
5. Wood Sleepers: Fabricated from wood blocking and plywood, configuration, sizes and length as detailed.
6. Fasteners: Are to be of sufficient length to penetrate concrete decks 52 mm (2 in.), metal decks 19 mm (3/4 in.) and wood decks 38 mm (1½ in.).
Acceptable Material:
 1. Nails: No. 10 spiral shank, hot dipped galvanized.
 2. Wood and Metal Deck Screws (Low profile head):
 1. Roofgrip #14 Buildex by ITW Construction Products
 2. #14 Heavy Duty Drill Point Fastener by Tru-Fast.
 3. Rawl #14 Deck Screw by Rawlplug Canada Ltd.
 3. Masonry anchors (Robertson head):
 1. Tapcon Plus, 6 mm (1/4 in.) diameter, Climaseal coated by ITW Construction Products.
 2. Tap-Grip heavy-duty self-tapping concrete anchors by Perma-Grip Fasteners.
 3. Rawl PERMA-SEAL TAPPER, 6 mm (1/4 in.) diameter by Rawlplug Canada Ltd.
 4. Steel: Flat head, self-tapping steel screw with coated finish, FM Approved. Fasteners to be of sufficient length to penetrate crest of metal deck 20 mm +/- 5 mm (3/4" +/- 1/4").
 5. Bolts, Washers and Nuts: Size as indicated on Drawings. Hot dipped galvanized, corrosion resistant finish, 12.5 mm (1/2") diameter unless otherwise noted.

PART 3 - EXECUTION

3.1 Preparation

1. Substrates shall be structurally sound to receive rough carpentry.
2. All wood framing shall be in accordance with Ontario Building Code or more stringent requirements noted within Contract Documents.

3.2 Installation

1. Cut and fit members accurately. Mitre all corners, leaving no space or unevenness greater than 3 mm (1/8 in.) between components. Lay out work to provide a uniform transition for insulation and membrane.
2. Install continuous plywood sheathing, wood blockings, cants, studs, nailers and continuous shims where required and detailed.
3. Shims to be of sufficient height to ensure a minimum ten percent (10%) positive slope is provided on all parapet walls and under cap flashings.
4. Erect members in position, align, level, square, plumb and secure permanently in place as specified. Brace work temporarily as required to maintain safely in place.

3.3 Fastening

1. Secure new wood with minimum of 2 fasteners at 457 mm (18 in.) on centre staggered, and as follows:
 1. Into masonry: masonry anchors.
 2. Into wood: wood screws.
 3. Into metal: metal screws.
2. Secure lumber as follows:
 1. All fasteners to be placed a minimum of 12 mm (1/2") from any edge. Install fasteners in two rows in direction of grain, with each fastener offset from one another not less than 457 mm (18") on centre.
 2. Offset and countersink all screw fasteners flush with surface of wood blocking being secured.
 3. Co-ordinate work to keep cutting and remedial work to a minimum.

3.4 Parapets/Perimeters/Walls/Curbs/Sleepers

1. Construct parapets, perimeters, walls, curbs and sleepers as detailed.
2. Provide new HVAC equipment wood sleeper supports. Width to be a minimum of 140 mm (5.5"). Length of sleeper to span between two framing members.

3. Where possible, maintain minimum height of 305 mm (12 in.) above finished roof surface for sleepers and curbs.
4. Install wood blocking for prefabricated curbs for mechanical units to allow for a level installation where deck is sloped.

3.5 Dividers and Movement joints

1. At dividers and movement joints, neatly cut plywood to required dimensions. Cutting shall be done by 'scoring' with carbide tipped utility tool/knife or circular saw with carbide blade. Smooth cut-edges with a wood rasp.
2. Secure plywood to substrate using appropriate fasteners, screws at 205 mm (8 in.) on centre each way and along perimeters. Maintain screws 13 mm (1/2 in.) from edges and maintain 3 mm (1/8 in.) gap between each piece of board.

3.6 Clean-up

1. Remove all excess materials, debris, tools and equipment as work proceeds and on completion.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Rough carpentry: Section 06100
2. Painting: Section 09900

1.2 Reference Standards

1. Do millwork to Millwork Standards of the Architectural Woodwork Manufacturers' Association of Canada (AWMAC) Premium Grade.

1.3 Samples

1. Submit duplicate 300 x 300 mm samples of each type of paneling laminate, melamine and each type of solid wood or plywood to receive stain or natural finish.
2. Submit sample of each type of hardware specified in accordance with Section 01340.
3. Submit a typical prototype unit representative of the work of this section.

1.4 Shop Drawings

1. Submit shop drawings in accordance with Section 01340.
2. Clearly indicate details of construction, profiles, jointing, fastening and other related details.

1.5 Qualification

1. Millwork manufacturer to have not less than 5 years proven first class experience in institutional millwork and shall be a member of AWMAC.

1.6 Warranty

1. Submit a two (2) year warranty for the work of this section against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 Materials

1. Softwood lumber: to CSA 0121-M1978 and National Lumber Grades Authority (NLGA) requirements, with maximum moisture content of 10% for interior work. Yard lumber select for natural finish of species, indicated to AWMAC premium grade.
2. Hardwood lumber: to National Hardwood Lumber Association (NHLA) requirements, moisture content of maximum 10% for interior work, of species indicated to AWMAC premium grade.

3. Hardwood plywood: to CSA 0115-1967 of thickness indicated, rotary cut face veneer, birch plywood, veneer core. Select veneers to provide book match veneer strips to be 240 mm wide minimum. Grade: Select White.
4. Nails and staples: to CSA B111-1974 galvanized for exterior work, interior high-humidity areas and for treated lumber; plain finish elsewhere. Use spiral thread nails except where specified elsewhere.
5. Particle Board core: to CAN3-0188.1-M, Grade R, 720 kg/m³ density in thicknesses indicated.
6. Book Match Veneer: strips to be 240 mm wide minimum.

2.2 Plastic Laminate

1. Conforming to CAN3-A172, General Purpose - standard grade (GP-S), 1.25 mm thick for tops, Post Forming - standard grade (PF-S) 1.25 mm thick for post forming. Balance all panels with 0.5 mm backing sheet (BK) by same manufacturer as face panel. Use waterproof adhesive capable of holding materials together without failure. Provide acid resistant grade where shown. Finish shall be "Velvatex" or "Suede" by Arborite, or equivalent manufactured by Formica, Durolam Ltd., "Wilson Art" as distributed by Meteor Plywoods Ltd., "Micarta" distributed by Montego Forest Products Ltd., "Nevamar" distributed by Ceratec Inc., or approved equivalent by Octopus Products Limited. Selections to be confirmed by Consultant.

2.3 Edge Banding

1. Solid polyvinyl chloride (PVC), 3 mm thickness x full width of panel edge, colour/pattern to match finished face of melamine panel or as selected by Consultant. All exposed edges of banding to be radiused to 2 mm radius after installation on panels. Submit sample of edge-banded panel with radiused edges to Consultant for approval prior to fabrication of architectural woodwork.
 - .1 Acceptable Material: Solid PVC edging as manufactured by "Woodtape" Edge-Banding.
 - .2 Acceptable Material: Solid PVC edging as manufactured by "Complast Inc."

2.4 Cabinet Hardware

1. Furnish and install all hardware to custom casework as follows:
 - .1 **Cupboard Doors - 19 mm thick:**

Hinges	200 Series 110° Salice
Roller Catches	807N 2G (SgDr) Onward
Elbow Catches	T03222 C15 (DhDr)
Door Pulls	CBH235-3 1/2" C32D

.2 Drawers - 19 mm thick.:

Drawer Slides	KV1300X length to suit
Drawer Pulls	CBH235-3 1/2" C32D
Drawer Locks	8703 - 14a National

.3 Shelving:

Plaster strips	KV255 Zinc Knappe & Vogt
Shelf Clips	KV256 Zinc Knappe & Vogt

.4 Cupboard Doors - 35 mm thick:

Hinges	F179 76x76 Stanley C15
Roller Catches	504N Onward C26
Surface bolt	043-4 X Angle Strike C15
Door Pulls	CBH245-4 1/2" C32D
Cupboard Locks	44F73-44FS3-626 Best Lock

.5 Closet Rods and Flanges

Rods: chrome finish, Ø 33 mm.

Flanges: chrome finish, closed flanges at both ends of rods.

2. This section shall also include accessories such as rubber door silencers (2 per drawer or door), and other items necessary for the completion of the millwork.
3. Cabinet Keying: Key all cabinet and drawer locks alike in each room, and different from other rooms.

2.6 Melamine Clad Cabinetwork

1. All cabinet frames whether for base, wall or tall floor standing cases, shall be fabricated so each is a self-contained module. Front side top and bottom, exterior and interior surfaces shall be finished allowing future relocation of any module, into any bench arrangement, without need of any additional finishing.
2. Gables and panels shall be fabricated from 19 mm thick melamine surfaced panels with a P.V.C. edging applied to exposed edges.
3. Bottoms shall be fabricated utilizing the same materials and edge finish as gables. Front edge will be edged with P.V.C. edging. All other edges will be thoroughly sealed and moisture proofed prior to attachment to gables.
4. Rails shall be fabricated and machined to join the gables and form a rigid cabinet frame.
5. Tops (applies to wall and tall units only) shall be fabricated utilizing the same material and edge finish as gables. Front edge will be edged with P.V.C. edging.
6. Toe kick rail shall have a 100 mm x 19 mm section, machined to receive four screw nails for attachment to bottom front edge of gables. Cabinet base shall be plywood attached to

melamine cabinet separately, insuring the melamine OSB centre core gables do not come in contact with the floor.

7. Backs in base cupboards shall be fabricated from a 6 mm thick melamine surfaced panel.
8. Backs in wall and tall cabinets shall be fabricated from 6 mm thick melamine surfaced panels securely glued and screw nailed into the check out provided in the backs of gables, tops, and bottoms.
9. All shelves shall be adjustable at 13 mm increments and each will be supported by a shelf support resting in four pilaster strips attached to the gables.
10. Doors shall be fabricated from 19 mm thick melamine surfaced panels. All four edges shall be P.V.C. edging.
11. Drawer fronts shall be fabricated utilizing the same material and edge finish as doors. All four edges shall P.V.C. edging. Fronts will be secured to drawer bodies with five screw nails through the front of the drawer body into the core of the drawer front.
12. Drawer bodies shall consist of box construction fabricated from 13 mm birch plywood with solid birch edge, front, sides and back with a 6 mm hardboard bottom dadoed and glued into box members. Joint front, sides and back with carefully fitted glued and tenoned joints. Alternately, Blum Metabox drawer body and side can be used.
13. 44 mm thick doors shall be solid core with melamine laminate both sides and on all four edges, color and grain to match melamine.
14. **Finish:**
 - .1 Melamine surfaced panels shall be finished both sides in the same colours, patterns, and grain as selected by the Consultant.
 - .2 Colour of all Melamine Cabinets to be **by Architect**.

2.7 Shop Fabrication

1. Shop install cabinet hardware.
2. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
3. Shop assemble work for delivery to site in size easily handled and to insure passage through building openings.

2.9 Plastic Laminated Tops

1. 19 mm thick particle board core with post-forming grade plastic laminate finish bonded with resorginal formaldehyde resin glue to a particleboard core. All countertop front face to return vertically 35 mm $\pm$. All front and backsplash edges to be rounded.

2. Underside to receive a backing sheet, sanded one side and bonded same as surfacing material.
3. Exposed edges to be finished with same material as used for the top.
4. Drip grooves to be cut into underside of the top where exposed edges occur.
5. Splash backs, curbs and curb shelves are to be of similar construction as the tops.
6. Use acid resistant post-forming grade laminate, where indicated on drawings. Colour: black.
7. At all wall termination, provide backsplash return.

2.10 Moulding and Trims

1. Fabricate mouldings in maximum practical lengths to profile shown. Solid birch to receive varnish finish unless noted otherwise. Install with concealed fasteners.

PART 3 - EXECUTION

3.1 Installation

1. Set and secure all material and components in place, rigid, plumb and square.
2. Provide heavy duty fixture attachments for wall mounted cabinets.
3. Use draw bolts in countertop joints.
4. At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant.
5. Apply water resistant building paper over wood framing members in contact with masonry or cementitious construction.
6. After installation, fit and adjust operating hardware for wood and laminated plastic cabinet doors, drawers and shelves.

End of Section

PART 1 - GENERAL

1.1 Section Includes

1. Note: in order to maintain continuity and quality control, the supply and installation of the full project scope of vapour barrier membrane is to be carried by a single trade.
2. Materials and installation methods of the primary air/vapour barrier membrane system.
3. Materials and installation methods of dampproof coursing and through-wall flashing membranes.
4. Materials and installation methods for the adhesion of rigid and semi-rigid insulating materials.

1.2 Related Sections

1. Masonry:	Section 04200
2. Building Insulation:	Section 07212
3. Firestopping and Smoke Seal:	Section 07270
4. Built Up Bituminous Roofing:	Section 07510
5. Sealants:	Section 07900
6. Aluminium Windows:	Section 08520

1.3 Submittals

1. Prior to commencing the Work, submit documentation from an approved independent testing laboratory certifying that the air leakage and vapour permeance rates of the air/ vapour barrier membranes, including primary membrane and transition sheets, exceed the requirements of the National Building Code.
2. Prior to commencing the Work submit copies of manufacturers' current ISO certification.
Membrane, primers, sealants, adhesives and associated auxiliary materials shall be included.
3. Prior to commencing the Work submit references clearly indicating that the membrane manufacturer has successfully completed projects on an annual basis of similar scope and nature for a minimum of fifteen years. Submit references for a minimum of ten projects.
4. Prior to commencing the Work submit manufacturers' complete set of standard details for the air/vapour barrier membrane systems showing a continuous plane of air tightness throughout the building envelope.

1.4 Quality Assurance

1. Submit in writing, a document stating that the applicator of the primary air/vapour barrier membranes specified in this section is recognized by the manufacturer as suitable for the execution of the Work.
2. Perform Work in accordance with the manufacturer's written instructions of the air/vapour barrier membrane and this specification.
3. Maintain one copy of manufacturer's written instructions on site.
4. At the beginning of the Work and at all times during the execution of the Work, allow access to Work site by the air/vapour barrier membrane manufacturers' representative.
5. Components used in this section shall be sourced from one manufacturer, including sheet membrane, air/vapour barrier sealants, primers, mastics and adhesives.

1.5 Mock-Up

1. Construct mock-up in accordance with Section 01340 - Shop Drawings, Product Data & Samples.
2. Provide mock-up of air/vapour barrier materials under provisions of Division 1.
3. Where directed by consultant, construct typical exterior wall panel, 2 m long by 2 m wide, incorporating substrate, window frame, attachment of insulation, and; showing air/vapour barrier membrane application details.
4. Allow 24 h for inspection of mock-up by consultant before proceeding with air/vapour barrier work. Mock-up may remain as part of the Work.

1.6 Pre-Installation Conference

1. Convene one week prior to commencing work of this section, under provisions of Division

1.7 Delivery, Storage and Handling

1. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.
2. Store roll materials on end in original packaging.
3. Store liquid air/vapour barrier material, adhesives and primers at temperatures of 5°C and above to facilitate handling.
4. Keep solvent away from open flame or excessive heat.
5. Protect rolls from direct sunlight until ready for use.

1.8 Co-ordination

1. Ensure continuity of the air/vapour barrier membrane system throughout the scope of this section.

1.9 Alternates

1. Submit requests for alternates in accordance with Division 1.
2. Alternate submission format to include:
 - .1 Submit evidence that alternate materials meet or exceed performance characteristics of Product requirements and documentation from an approved independent testing laboratory certifying that the air leakage and vapour permeance rates of the air/ vapour barrier membranes, including primary membrane and transition sheets, exceed the requirements of the National Building Code.
 - .2 Submit copies of manufacturers' current ISO certification.
 - .3 Submit references clearly indicating that the membrane manufacturer has successfully completed projects on a annual basis of similar scope and nature for a minimum of fifteen years.
 - .4 Submit manufacturers' complete set of standard details for air/vapour barrier membrane systems showing a continuous plane of air tightness throughout the building envelope.
3. Submit requests for alternates to this specification a minimum of ten (10) working days prior to tender closing for evaluation. Include a list of ten projects executed over the past ten years.
4. Acceptable alternates will be confirmed by addendum. Substitute materials not approved in writing prior to tender closing shall not be permitted for use on this project.

PART 2 - PRODUCTS

2.1 Membranes

1. Transition and continuous wall envelope barrier membrane (Self-Adhering): Basis of design is Blueskin® SA as manufactured by Bakor, a SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film, or approved equal,. For application temperatures down to - 12°C use Blueskin® SA LT. Membrane shall have the following physical properties:
 - .1 Thickness: 1.0 mm (40 mils);
 - .2 Air leakage: <0.005 L/s•m² @ 75 Pa to ASTM E283-91;
 - .3 Water vapour permeance: 2.8 ng/Pa.m².s (0.05 perms) to ASTM E96;
 - .4 Low temperature flexibility: -30°C to CGSB 37-GP-56M;
 - .5 Elongation: 200% to ASTM D412-modified.

2. Through-wall flashing membrane and dampproof course (Self-Adhering): Blueskin TWF as manufactured by Bakor, a SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film, having the following physical properties:
 - .1 Film Thickness: 0.225mm (9.0 mils);
 - .2 Puncture Resistance (film); 180N minimum;
 - .3 Tear Resistance (film); 58N MD;
 - .4 Air leakage: $<0.005 \text{ L/s}\cdot\text{m}^2$ @ 75 Pa to ASTM E283-91;
 - .5 Water vapour permeance: $2.8 \text{ ng/Pa}\cdot\text{m}^2\cdot\text{s}$ (0.05 perms) to ASTM E96;
 - .6 Low temperature flexibility: -30°C to CGSB 37-GP-56M.

Approved Equal: Air-Shield Thru-Wall Flashing by W.R. Meadows of Canada and AquaBarrier TWF by IKO Industries.

2.2 Primers

1. Primer for self-adhering membranes: For all temperatures, Blueskin Primer as manufactured by Bakor, a synthetic rubber based adhesive type, quick setting, having the following physical properties:
 - .1 Colour: Blue;
 - .2 Weight: 0.8 kg/l;
 - .3 Solids by weight: 35%;
 - .4 Drying time (initial set): 30 minutes.

Approved Equal: S.A.M. Adhesive / S.A.M. Adhesive LVC by IKO Industries

2. Primer for self-adhering membranes: For temperatures above -4°C , Aquatac™ Primer as manufactured by Bakor, or approved equal, a polymer emulsion based adhesive type, quick setting, having the following physical properties:
 - .1 Colour: Aqua;
 - .2 Weight: 1.0 kg/l;
 - .3 Solids by weight: 53%;
 - .4 Water based, no solvent odours
 - .5 Drying time (initial set): 30 minutes at 50%RH and 20°C .

2.3 Adhesive

1. Liquid air seal mastic and insulation adhesive: Air-Bloc 21 or 230-21 Insulation Adhesive as manufactured by Bakor, a synthetic, trowel applied, rubber based adhesive type, having the following characteristics:
 - .1 Compatibility: With air/vapour barrier membrane, substrate and insulation.
 - .2 Air leakage: $0.013 \text{ L/s}\cdot\text{m}^2$ @ 100 Pa.;
 - .3 Water vapour permeance: $1.7 \text{ ng/Pa}\cdot\text{m}^2\cdot\text{s}$. (0.03 perms);
 - .4 Long term flexibility: CGSB 71-GP-24M;
 - .5 Chemical resistance: Alkalies and salt.

PART 3 - EXECUTION

3.1 Examination

1. Verify that surfaces and conditions are ready to accept the Work of this section. Notify in writing of any discrepancies. Commencement of the work or any parts thereof shall mean acceptance of the prepared substrate.

3.2 Preparation

1. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill spawled areas in substrate to provide an even plane. Strike masonry joints flush.
2. New concrete should be cured for a minimum of 14 days and must be dry before air/vapour barrier membranes are applied.
3. Where curing compounds are used they must be clear resin based without oil, wax or pigments.

3.3 Primer for Transition and Through-wall Flashing Membrane (Self-Adhering Type only)

1. Apply primer to poured concrete, metal and glass-faced wallboard substrates at rate recommended by manufacturer. Primer not required on concrete block.
2. Allow primer to dry prior to application of the membrane.

3.4 Transition Membrane (Self-Adhering Type)

1. Align and position Blueskin, or approved equal, self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm overlap at all end and side laps.
2. Tie-in to window frames, aluminium screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings.
3. Promptly roll all laps and membrane with a counter top roller to effect seal.

3.5 Through-wall Flashing & Dampproof Coursing (Torch Applied)

1. Where torch applied through-wall flashing & dampproof coursing are indicated on drawings, install Blueskin® TG membrane on primed and prepared surfaces in accordance with manufacturer's written instructions. Approved equal AquaBarrier TG by IKO Industries
2. For through-wall flashing ensure membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.
3. Apply through-wall flashing membrane along the base of masonry veneer walls, over

windows, doors and all other wall openings. Membrane shall form continuous flashing and shall extend a minimum of 200 mm up the back-up wall.

3.6 Through-wall Flashing Membrane (Self-Adhering Type)

1. Align and position the leading edge of Blueskin® TWF self-adhering through-wall flashing membrane with the front horizontal edge of the foundation walls or self angles, partially remove protective film and roll membrane over surface and up vertically.
2. Press firmly into place. Ensure minimum 50mm overlap at all end and side laps.
3. Promptly roll all laps and membrane to effect the seal.
4. Ensure all preparatory work is complete prior to applying Blueskin® TWF.
5. Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.
6. Apply through-wall flashing membrane along the base of masonry veneer walls, over windows, doors and all other wall openings. Membrane shall form continuous flashing and shall extend up a minimum of 200 mm up the back-up wall.

3.7 Heat Sensitive Transition Membrane (Self-Adhering Type)

1. Align and position Blueskin® SA self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm overlap at all end and side laps.
2. Tie-in to window frames, aluminium screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings.
3. Promptly roll all laps and membrane with a countertop roller to affect seal.

3.8 Inspection

1. Notify consultant when sections of work are complete so as to allow for review prior to installing insulation.

3.9 Protection of Finished Work

1. Blueskin is not designed for exposure. Good practice requires covering as soon as possible.

End of Section

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

1. Masonry: Section 04200
2. Air Vapour Barrier Membrane: Section 07112
Note: in order to maintain continuity and quality control, the supply and installation of the full project scope of vapour barrier membrane is to be carried by a single trade.

PART 2 - PRODUCTS

2.1 Insulation

1. **Perimeter Foundation Insulation:** Extruded expanded polystyrene to CAN/CGSB-51.20-M87, Type 4, butt or shiplapped edges. For use at perimeter of building and at perimeter of basement areas above and below grade as well as at miscellaneous detail locations calling for rigid insulation.
 - .1 Thickness 75 mm (3.0 in.) (RSI 1.76/R 10.0) - where so indicated.
 - .2 Acceptable Material: "Styrofoam SM" as manufactured by Dow Chemical Canada Inc.
 - .3 Acceptable Material: "Celfort 300" as manufactured by Celfortec Inc.
2. **Cavity Wall Insulation - Masonry:** Expanded polystyrene insulation to CAN/CGSB-51.20-M87, Type 4 butt or ship lapped edges. For use in cavity wall construction above and below grade.
 - .1 Thickness 100 mm or as indicated.
 - .2 Acceptable Material: "Cavitymate" Type 3 as manufactured by Dow Chemical Canada Inc.
 - .3 Acceptable Material: "Celfort 300" as manufactured by Celfortec Inc. or approved equal.
3. **Cavity Wall Insulation – Metal Panel:** water-repellent and semi-rigid thermal insulation to CAN/ULC-S702-97, formed of bonded basalt fibres. For use in cavity wall construction or portions thereof with metal panel or siding cladding.
 - .1 Acceptable Material: 100mm "CavityRock MD" as manufactured by Rockwool Inc.
 - .2 Acceptable Material: 100mm "MB PLUS" as manufactured by Fibrex Insulations Inc.

2.2 Adhesive

1. Type A: to CGSB 71-GP-24M plus Amdt-Nov.-83, compatible with respective rigid insulation, air, vapour and waterproofing membranes and recommended by manufacturer's. Use Bakor 230-21 rigid insulation adhesive with Blueskin air-vapour barrier.

PART 3 - EXECUTION

3.1 Workmanship

1. Install insulation after building substrata materials are dry, thoroughly clean and capable of providing a firm, uniform bonding surface.
2. Install insulation to maintain continuity of thermal protection to building elements and spaces.
3. Fit insulation closely around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
4. Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use longest possible lengths to reduce number of joints.
5. In multiple layer applications offset both vertical and horizontal joints.
6. Do not enclose insulation until it has been inspected.
7. Install semi rigid board to manufacturer's requirements.

3.2 Rigid Insulation

1. **Cavity Walls Above Grade**
Press insulation in full contact with air/ vapour barrier membrane by installing plastic wedges "Wedge-Lok" between the masonry reinforcing and the insulation. Wedges at 400 mm o.c. vertically and horizontally. Apply adhesive on board edges and press boards tightly to prevent air infiltration between boards.
2. **Cavity Walls Below Grade**
Apply adhesive to insulation board by bead method with 4 mm diameter beads at 350 mm o.c.
3. **Perimeter Insulation**
Apply adhesive to insulation board by spot method with daubs 40 mm diameter x 25 mm high at 200 mm o.c. each way.

End of Section

PART 1 - GENERAL

1.1 Summary of Work

1. This Section specifies foamed-in-place insulation.

1.2 Related Requirements

1. Air Vapour Barrier Membrane	Section 07112
2. Rigid Insulation	Section 07212
3. Composite Building Panels	Section 07421
4. Sheet Metal Flashing and Trim	Section 07620

1.3 Reference Standards

1. ASTM International (ASTM).
 - .1 ASTM D2842-[2006], Standard Test Method for Water Absorption of Rigid Cellular Plastics.
 - .2 ASTM E96/E96M-[2010], Standard Test Methods for Water Vapor Transmission of Materials.
 - .3 ASTM E2178-[2003], Standard Test Method for Air Permeance of Building Materials.
2. Canada Green Building Council (CaGBC).
 - .1 LEED Canada-NC [2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations including Addendum 2007.
3. National Research Council of Canada (NRC).
 - .1 Canadian Construction Materials Centre (CCMC) Reports.
4. Underwriter's laboratories of Canada (ULC).
 - .1 CAN/ULC S102-[2010], Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC S127-[2007], Standard Corner Wall Method of Test for Flammability Characteristics of Non-Melting Building Materials.
 - .3 CAN/ULC-S705.1-[2001], Standard for Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Material – Specification.
 - .4 CAN/ULC-S705.2-[2005], Standard for Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Application.
 - .5 CAN/ULC-S774-[2009], Standard Laboratory Guide for the Determination of Volatile Organic Compound Emissions from Polyurethane Foam

1.4 Administrative Requirements

1. Co-ordination: Co-ordinate work of this Section with work of other trades for proper time and sequence to avoid construction delays.
2. Pre-Application Meeting: Convene pre-application meeting after Award of Contract and one week prior to commencing work of this Section to verify project requirements, substrate conditions and coordination with other building sub-trades, and to review manufacturer's written application recommendations.
 - .1 Notify attendees 2 weeks prior to meeting and ensure meeting attendees include as minimum:
 - .1 Owner;
 - .2 Consultant;
 - .3 Spray polyurethane foam insulation applicator;
 - .4 Manufacturer's Technical Representative;
 - .5 Manufacturer's third-party quality assurance provider.
 - .2 Ensure meeting agenda includes review of methods and procedures related to medium density closed-cell spray polyurethane foam insulation application including co-ordination with related work.
 - .3 Record meeting proceedings including corrective measures and other actions required to ensure successful completion of work and distribute to each attendee within 1 week of meeting.

1.5 Action and Informational Submittals

1. Make submittals in accordance with Contract Conditions.
2. Product Data: Submit product data including manufacturer's literature for medium density closed-cell spray polyurethane foam insulation components and accessories, indicating compliance with specified requirements and material characteristics.
 - .1 Submit list on spray polyurethane foam insulation manufacturer's letterhead of materials, components and accessories to be incorporated into work.
 - .2 Include details of insulation joints with sealants.
 - .3 Include product names, types and series numbers.
 - .4 Include contact information for Manufacturer and their representative for this Project.
3. Test Reports:
 - .1 Submit test reports showing compliance with specified performance characteristics and physical properties including thermal performance.
4. Field Reports: Submit third party inspection agency's field reports within ten (10) days of agency representative's site visit and inspection.
5. Sustainable Design (LEED).
 - .1 LEED Submittals: Not Applicable
6. Applicator Qualifications:
 - .1 Submit letter on spray polyurethane foam insulation manufacturer's letterhead verifying applicators' license for work similar to work of this Section.

1.6 Closeout Submittals

1. Operation and Maintenance Data: Supply maintenance data for foamed-in-place insulation for incorporation into manual.
2. Record Documentation:
 - .1 List materials used in foamed-in-place insulation work.
 - .2 Warranty: Submit warranty documents specified.

1.7 Quality Assurance

1. Sustainability Standards Certification (LEED).
 - .1 LEED Canada-NC submittals: Not applicable
2. Mock-up: Construct full size 3 x 3 m mock-up of spray polyurethane foam insulation using proposed procedures, materials and quality of work where directed by Consultant.
 - .1 Include window and frame and sill, insulation, building corner condition, junction with roof system and how materials interface with sealants.
 - .2 Purpose: To judge quality of work and material application.
 - .3 Allow Consultant 24 hours minimum prior to inspection of mock-up.
 - .4 Do not proceed with work prior to receipt of written acceptance of mock-up by Consultant.
 - .5 When accepted, mock-up will demonstrate minimum standard of quality required for work of this Section.
 - .6 Approved mock-up will remain part of finished work.
3. Applicator Qualifications: Verify that applicator of spray polyurethane foam insulation is currently licensed by manufacturer.

1.8 Delivery, Storage and Handling

1. Delivery and Acceptance Requirements:
 - .1 Deliver material in accordance with manufactures recommendations.
2. Deliver closed-cell spray polyurethane foam insulation materials and components in manufacturer's original packaging with identification labels intact and in sizes to suit project.
3. Storage and Handling Requirements: Store materials off ground and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
4. Packaging Waste Management:
 - .1 Separate and recycle waste packaging materials.

- .2 Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper and plastic material in appropriate on-site storage containers for recycling in accordance with Waste Management Plan.

1.9 Warranty

1. Project Warranty: Refer to Contract Conditions for project warranty provisions.
2. Manufacturer's warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not intended to limit other rights Owner may have under Contract Conditions.
3. Warranty period: One (1) year commencing on Date of Substantial Performance of work.
 - .1 Warranty: includes coverage of applied closed-cell spray polyurethane foam insulation which:
 - .1 Fail to achieve air tight and watertight seal.
 - .2 Exhibit loss of adhesion or cohesion.
 - .3 Do not cure.

PART 2 - PRODUCTS

2.1 Manufacturer

1. Manufacturer:
 - .1 Icynene Inc., Mississauga, Ontario
 - .2 BASF Canada
 - .3 IPI Canada
 - .4 Insulthane Extreme – Elastochem Specialty Chemicals, Canada

2.2 Description

1. Spray applied medium density closed-cell spray polyurethane foam insulation.
Thickness required as per drawings and details.

2.3 Design Criteria

1. Thermal Resistance: To CAN/ULC-S770, 1.93 minimum RSI at 50 mm thickness.
2. Vapour Permeability: To ASTM E96, 56 ng/Pa.s.m² at 50 mm thickness.
3. Water Absorption % by Volume: To ASTM D2842, 0.40 %.
4. Flame Spread: To CAN/ULC S102 (S127), 290.
5. VOC's: To CAN/ULC-S774: Pass.

2.4 Materials

1. Medium density closed-cell spray polyurethane foam insulation to CAN/ULC-S705.1.
2. Acceptable Material:
 - .1 Icynene Inc., ICYNENE MD-C- 200-v2

- .2 Walltite Eco v.3 CT by BASF Canada
- .3 ISOFOAM - SPF by IPI Canada

2.5 Accessories

1. Joint Sealants:
 - .1 Ensure sealants are compatible with spray polyurethane foam insulation.
2. Air/Vapour Barriers:
 - .1 Ensure air-vapour barrier is compatible with spray polyurethane foam insulation. Refer to Section 07112 Air Vapour Barrier Membrane.
3. Fire Stop:
 - .1 Ensure Fire Stop materials are compatible with spray polyurethane foam insulation. Refer to Section 07212 Rigid Insulation.

PART 3 – EXECUTION

3.1 Applicators

1. Use only spray insulation licensed applicators for work of this Section.

3.2 Examination

1. Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for closed-cell spray polyurethane foam insulation application in accordance with manufacturer's written recommendations.
 - .1 Visually inspect substrate in presence of Consultant.
 - .1 Ensure substrates are clean of oil or excess dust.
 - .2 Ensure that there is no surface spalling.
 - .3 Ensure sealants completely fill gaps in substrate and at joints.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with application only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.3 Preparation

1. Remove loose or foreign matter, which might impair adhesion of materials.
2. Fill open joints and voids in concrete greater than 25 mm.
3. Ensure substrates are free of surface moisture prior to application of closed-cell spray polyurethane foam insulation.
4. Ensure fire block details are installed and reviewed before any spray foam application.

3.4 Application

1. Apply medium density, closed-cell spray polyurethane foam insulation to CAN/ULC-S705.2.
2. Site mix liquid components in accordance with manufacturer's written recommendations.
3. Spray apply medium density closed-cell polyurethane foam insulation evenly in

15 mm to 50 mm thick increments as indicated.

.1 Thickness: 15 mm minimum, 50 mm maximum.

4. Perform work in accordance with manufacturer's written recommendations.

3.5 Field Quality Control

1. Field Inspection: Will be carried out by the Consultant.

.1 Schedule site visits to review work at stages listed:

.1 Twice during progress of work at 25% and 60% complete.

.2 Upon completion of work, after cleaning is carried out.

.3 Report deficiencies immediately to Consultant.

.4 Obtain reports within ten (10) days of review and submit immediately to Consultant.

.2 Site Application Tolerances:

.1 Thickness: ± 6 mm of thickness indicated.

2. Manufacturer's Services:

.1 Co-ordinate manufacturer's services.

.1 Have manufacturer's technical representative review work involved in handling, application and protection of closed-cell spray polyurethane foam insulation, and submit written reports in acceptable format to verify compliance of work with Contract conditions.

.2 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for product application review in accordance with manufacturer's written recommendations.

.1 Report any inconsistencies from manufacturer's recommendations immediately to Consultant.

.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of closed-cell spray polyurethane foam insulation, and when preparatory work on which work of this Section depends is complete, but before application begins.

.2 Upon completion of work, after cleaning is carried out.

3.6 Cleaning

1. Progress Cleaning: Perform cleanup as work progresses.

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

2. Final Cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment.

3. Waste Management:

.1 Co-ordinate recycling of waste materials.

.2 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

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

3.7 Protection

1. Protect applied materials from damage during construction.
2. Repair damage to adjacent materials caused by medium density closed-cell spray polyurethane foam Insulation application.

End of Section

PART 1 - GENERAL

1.1 Description of Work

1. The work of this section shall include, but is not limited to: Interior fireproofing, concealed from view and direct contact

1.2 Related Work

1. Fire Stopping and Smoke Seals	Division 07270
2. Building Insulation	Division 07212
3. Structural Steel Framing	
4. Steel Joist Framing	
5. Metal Decking	
6. Mechanical Division 15	Re: Patching
7. Electrical Division 16	Re: Patching

1.3 Quality Assurance

1. Installer: Contractor shall be approved by manufacturer, and be experienced in installing specified products, and is approved by the manufacturer of the fireproofing products. A manufacturer's willingness to sell products to an installer engaged by contractor, does not in itself confer qualification on the buyer.
2. Single Source: Obtain spray applied fireproofing products from a single source for each product required. Provide secondary materials, which are acceptable to the fireproofing manufacturer which, are included in the tested and/or listed designs.
3. Fire Resistance: Provide fireproofing materials that have been listed and classified by one or more of the following testing authorities: Underwriters Laboratories of Northbrook, IL and/or Underwriters Laboratories of Scarborough, Ontario; Warnock Hersey or other testing and inspecting agency acceptable to the architect and authorities having jurisdiction.
4. Packaging: All products must be packaged with proper identifications and approval indications acceptable to the testing and/or listing agency.
5. Asbestos: Manufacturer shall provide Certification that products supplied are 100% asbestos free.
6. Steel Surfaces: **Structural steel and steel decking shall be unprimed.**
7. Painted Steel Surfaces: Steel surfaces requiring fireproofing that are painted and/or primed, shall meet UL requirements for application and adhesion characteristics. Provide certifications from fireproofing manufacturer of compatibility of fireproofing and painted systems. Restrictions published by UL shall apply.
8. Remedial Work: Steel surfaces with incompatible primers or paint shall be either removed, lathed, or otherwise remedied within the requirements of UL, so that adequate and approved bonding can occur, acceptable to authorities having jurisdiction.

1.4 Project Conditions

1. Environmental Limitations: Do not apply sprayed fireproofing material when ambient or substrate temperatures are 40 deg. F. (4 deg C) or lower, unless temporary heat and protection is provided to maintain temperatures at or above this level for 24 hours before, during and 24 hours after application of fireproofing.
2. Ventilation: Ventilate building spaces during and after application of fireproofing at a rate of four (4) air changes per hour until fireproofing is dry. If natural ventilation is insufficient, employ mechanical means as necessary.
3. Surfaces to be sprayed: Surfaces to be sprayed must be free of any substance that would impair proper adhesion.
4. The contractor shall make available to the fireproofing contractor suitable area(s) for permanent locations for mixing and pumping fireproofing. This site must be:
 - .1 Convenient to the structure
 - .2 Be able to accommodate delivery of product
 - .3 Allow for space for truck storage and trailer parking, and for materials and Equipment
 - .4 Be well drained
 - .5 Be near a suitable source of potable water of quantity required
 - .6 Have a proper source of electrical power, if required.
 - .7 Provide temporary heat and ventilation to comply with manufacturers recommendations

1.5 Sequencing

1. Sequence and coordinate application of sprayed fireproofing with other related work specified in other Sections to comply with the following requirements:
2. Provide temporary enclosure for interior applications to prevent deterioration of applied materials exposed to unfavorable environmental conditions.
3. Avoid exposure of fireproofing to unnecessary damage or abrasion.
4. Do not apply fireproofing until all hangers, clips and other necessary supports are in place, requiring penetration of fireproofing if installed after the application of fireproofing.
5. Ducts, piping and other items that would interfere with the application of fireproofing shall not be installed, until application is completed.

1.6 Application Parameters

1. The fireproofing contractor shall be allowed to move freely to apply products as necessary. Materials stored on the floor, shall be protected by the contractor, or relocated if these materials prevent the proper application of fireproofing.

2. Patching, repairing and cleaning of fireproofing, due to damage done by others, shall be performed by the fireproofing applicator.
3. After completion of fireproofing, the fireproofing applicator shall remove all equipment, and broom sweep all floor areas of overspray materials.
4. Application of fireproofing shall not commence until the project is at a stage to allow the applicator to apply product continuously and efficiently, without undue interference and delay by other trades.
5. Conference: Convene a pre-installation conference to establish a procedure to maintain optimum working conditions and to coordinate this work with related an/or adjacent work.

1.7 Submittals, References and Applicable Standards

1. Product Data: Submit manufacturer's product data, installation instructions, use and limitations for each material used, and applicable fire test designs, as listed by approved fire testing organization.
2. Performance Certification: Submit manufacturer's verification of performance criteria, fire performance and compliance with applicable standards.
3. Applicable Standards and Test Methods:

Products Submitted shall be tested in accordance with the following ASTM test methods:

- .1 E 119 Fire Test of Building Construction and Materials
- .2 E 84 Test for Surface Burning Characteristics of Building Materials
- .3 E 136 Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
- .4 E 605 Thickness and Density of Sprayed Fire Resistive Materials Applied to Structural Members
- .5 E 736 Cohesion/Adhesion of Sprayed Fire Resistive Materials Applied to Structural Members
- .6 E 759 Effect of Deflection of Sprayed Fire Resistive Materials Applied to Structural Members
- .7 E 760 Effect of Impact on Bonding of Sprayed Fire Resistive Materials Applied to Structural Members
- .8 E 761 Compressive Strength of Sprayed Fire Resistive Materials Applied to Structural Members
- .9 E 859 Air Erosion of Sprayed Fire Resistive Materials Applied to Structural Members
- .10 E 937 Corrosion of Steel By Sprayed Fire Resistive Materials Applied to Structural Members
- .11 AWCI "Inspection Procedure for Field Applied Sprayed Fire Protection Materials", and the current UBC Standard on: "Thickness and Density Determination for Spray Applied Fire Protection"
- .12 G 21 Determining Resistance of Synthetic Polymeric Materials to Fungi

1.8 Warranty

1. General Warranty: Submit a written warranty, executed by the contractor and cosigned by the installer, agreeing to repair or replace sprayed fireproofing materials that fall within the specified warranty period.
 - .1 Failures include, but are not limited to cracking, flaking, eroding in excess of specified requirements, peeling and delaminating of sprayed fireproofing from substrates due to defective materials or installation. Not covered in this warranty are failures due to damage by others.
2. Warranty Period: 2 years, from date of substantial completion.

PART 2 - PRODUCTS

2.1 Manufacturers

1. Manufacturers of fire resistive materials having product considered acceptable for use:
 - .1 AD Fire Protection Systems
 - .2 Caico Industries Inc.
 - .3 Grace Canada Inc.

2.2 MATERIALS

1. **Concealed Cementitious Fireproofing:** meeting the below listed minimum physical properties, for use in locations not subject to physical contact or abuse; eg. Southwest Vermiculite Co. Inc. and licensed manufacturers of Type 5 GP (AD Fire Protection Systems).
 - .1 Physical Properties: Minimum values unless otherwise indicated, or higher values required to attain designated fire resistance ratings, measured per standard ASTM test methods referenced above in section 1.08, Part C.
 - .1 E 84: Flame Spread 0, and Smoke Developed 0.
 - .2 E 136: Passes, and is determined non-combustible
 - .3 E 605: Density shall be a minimum of 15 pcf.
 - .4 E 736: Cohesion/Adhesion shall be 200 psf, with 150 psf minimum acceptable level; if primed steel is used, comply with requirements published by U.L.I.
 - .5 E 759: No cracking, spalling or delamination
 - .6 E 760: Impact: No delamination, cracking or spalling
 - .7 E 761: Compression shall be 5.0 lb/sq. in.
 - .8 E 859: Erosion shall be 0.00 gr/sq.ft. maximum
 - .9 E 937: Corrosion: No evidence of corrosion allowed
 - .10 G 21: Mold Resistance: No evidence of growth
 - .2 Structural members not meeting minimum size requirements specified in a design shall receive a thickness of fireproofing consistent with the member's W/D ratio.

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2. **Exposed Fireproofing:** For exposed applications of sprayed fire-resistive materials, provide manufacturers standard products complying with requirements for materials and composition having the following minimum physical properties measured per ASTM standard test methods referenced above; eg. Southwest Vermiculite Co. Inc. and licensed manufacturers of Type 5 GP (AD Fire Protection Systems).
- .1 Physical Properties:
- .1 E 84: Flame Spread 0, and Smoke Developed 0
 - .2 E 136: Passes, and is determined non - combustible
 - .3 E 605: Density shall be a minimum of 22 pcf.
 - .4 E 736: Cohesion/Adhesion shall be 500 psf for products with a minimum density of 22 pcf, and 1000 psf for products with density above 35 pcf.
 - .5 E 759: No cracking or delamination
 - .6 E 760: Impact: No delamination, cracking or spalling
 - .7 E 761: Compression shall be 100 psi for products with a minimum density of 22 pcf, and 300 psi for products with densities over 35 pcf.
 - .8 E 859: Erosion shall be 0.00 gr/sq.ft.
 - .9 E 937: Corrosion: No evidence of corrosion allowed
 - .10 G 21: Mold Resistance: No evidence of mold growth
3. **Refractory Mineral Wool Fire Protection:** Rigid boards of 9 pcf nominal density; produced from asbestos free materials by combining refractory mineral wool manufactured from slag with thermosetting resin binders to comply with ASTM C612 for Class 4 and as follows:
- .1 Thermal Conductivity (R Value): 4.35 at 75 degrees F (23.9 degrees Celsius).
 - .2 Surface Burning Characteristics: Flame Spread and Smoke Developed ratings of 15 and 5, respectively.
 - .3 Manufacturer and Product Name: eg. Cafco-board Mineral Wool Board Fire Protection by Cafco Industries Inc.
4. **Fastening Accessories:** For each fire resistive assembly in which mineral wool board fire protection serves as rigid fire protection, provide a board fastening system complying with the related UL design or other acceptable testing and inspecting organization's report.
5. **Miscellaneous Materials:** Provide the following materials as standard with each of the fireproofing systems, as recommended by the manufacturer for each condition and substrate.
- .1 Primers: It is not recommended that any structural steel primers are used on any steel surfaces, unless tested and listed by ULI in designs proposed to be used. Compatible primers may be used, providing the fireproofing manufacturer can verify such compatibility in accordance with UL requirements.
 - .2 Adhesives: Provide adhesives as necessary, to comply with manufacturer requirements for adhesion of fireproofing. Acceptable adhesives are:
 - .1 TC 55 water based acrylic adhesive
 - .2 Type DK Spatter Coat

- .3 Reinforcements: Provide fiberglass mesh or wire lath for areas where adhesion is not compatible and for application of fireproofing to steel joists.
- .4 Mold Inhibitor: Provide factory added mold inhibitor tested in accordance with ASTM G 21 for areas such as hospitals, testing laboratories, health facilities and other areas of hygienic requirements.
- .5 Top Coats: Use as required and recommended by fireproofing manufacturer or compatible products.

PART 3 – EXECUTION

3.1 Pre-Installation Examination:

The applicator and the contractor shall examine surfaces to be fire protected, and determined if the surfaces are satisfactory. Substrate conditions must comply with the following:

- 1. Substrates must be free of grease, oil, rolling compounds, incompatible primers, loose mill scale, dirt or any other foreign matter which would prevent proper bonding of fireproofing. Structural steel shall be unprimed. Steel roof and floor decking shall be galvanized only.
- 2. Any objects such as hangers, piping attachments, and other suspended retainer devices shall be properly secured.
- 3. Ducts, piping, and other equipment shall not be placed or suspended until the Fireprotection materials are in place.

3.2 Preparation:

- 1. Clean any substrate not ready to receive fireproofing. Consult with manufacturer if conditions exist not easily remedied.
- 2. Apply adhesives as necessary.
- 3. Cover all work subject to oversprays during application. Provide temporary enclosure when necessary to temporarily confine fireproofing and protect the environment.
- 4. Assure maintenance of ambient temperatures, and/or heat and ventilation when required.

3.3 Installation, General

- 1. Comply with manufacturers written application instructions and procedures for mixing, conveying and applying products, in accordance with the types of recommended equipment, admixtures and specific procedures regarding special conditions.
- 2. Coat substrates with adhesives if necessary.

3. Extend fireproofing materials in full thickness per approved design, to be protected. Unless otherwise recommended, install fireproofing complete in each area, prior to another.
4. Provide a uniform surface matching UL requirements for designs approved. Apply products at the minimum densities required, or greater.
5. Cure fireproofing to prevent premature drying; protect from freezing as listed in Section 1.05 of this specification.
6. Exposed to View Applications: Where exposed to view, provide appearance of Fireprotection as follows:
 - .1 Provide a troweled surface of appearance previously determined prior to installation
 - .2 Surfaces shall be within tolerances of 1/16 inch
 - .3 Mask edges of termination's so as to achieve neat and sharp edges.

3.4 Field Quality Control:

1. Testing Agency: The owner shall engage and the contractor and applicator shall approve a qualified independent testing agency to perform field quality inspections of applied fireproofing, and prepare reports.
 - .1 Testing shall be done in accordance with the AWCI "Technical Manual 12 - A, Standard Practice for the Testing and Inspecting of Field Applied Sprayed Fire - Resistive Materials" and ASTM E 605.
 - .2 Tests shall be done on thickness, density and adhesion
 - .3 Variances shall be corrected with the testing agency present, and when the applicator is performing work in the same area, to allow for expedient corrections.
 - .4 A schedule of tests to be performed shall be agreed upon by applicator, contractor and testing agency.

3.5 Cleaning and Repair:

1. After completion of each day's work, the applicator shall broom clean the area fireproofed. Areas not to receive fireproofing but are finished surfaces shall be masked.
2. All patching of damaged fireproofing shall be completed by applicator.

3.6 Protection:

1. Provide final protection and maintain conditions in a manner acceptable to Consultant and authorities having jurisdiction.
2. Ensure fire protection is not damaged at time of Substantial Performance of the Work.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Cast-in-Place Concrete:	refer to structural drawings
2. Masonry:	Section 04200
3. Rough Carpentry (Architectural) Plywood:	Section 06100
4. Gypsum Board:	Section 09250
5. Firestopping and Smoke Seals for Mechanical Work:	Division 15
6. Firestopping and Smoke Seals for Electrical Work:	Division 16
7. Sound Seal at Gypsum Board Partition	Section 09250

Note: Firestopping and Smoke Seals within mechanical and electrical assemblies are specified in Divisions 15 and 16. All other firestopping and smoke seals are the responsibility of this Section.

1.2 Reference

1. ASTM E814 - Test Method of fire tests of through-penetration firestops, Factory Mutual.
2. CAN4-S101M - Standard Methods of Fire Endurance Tests of Building Construction and Materials.
3. CAN4-S115M - Standard Method of Fire Tests of Firestop Systems.
4. ULC - List of Equipment and Materials.

1.3 System Description

1. Firestopping Materials: CAN4-S115M ASTM E814 to achieve a fire protection rating as noted on Drawings.
2. It is the intent of this Section that in conjunction with Divisions 15 and 16 a competent, single source be responsible for the firestopping and smoke seals of the entire project.

1.4 Submittals

1. Submit a product data to requirements of Section 01340.
2. Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation, ULC design references.

3. Submit proposed type of fireproofing system for each location for approval by Architect. Fireproofing System must be appropriate to achieve expected appearance and finish.

1.5 Quality Assurance

1. Manufacturer: Company specializing in manufacturing products of this Section with minimum five years documented experience.
2. Applicator: Approved, licensed and supervised by the manufacturer of firestopping materials. Company with minimum five years documented experience.
3. Product: Manufactured under ULC Follow-up Program. Each container or package shall bear ULC label.

1.6 Regulatory Requirements

1. Conform to applicable code for fire protection ratings.
2. Provide certificate of compliance for authority having jurisdiction indicating approval.

1.7 Delivery, Storage & Handling

1. Deliver and store materials in a dry, protected area, off ground in original, undamaged, sealed containers with manufacturer's labels and seals intact.

1.8 Project & Site Conditions

1. Application temperature and ventilation as per Manufacturer's instructions.

1.9 Sequencing & Scheduling

1. Sequence work to permit installation of firestopping and smoke seal materials to be installed after adjacent work is complete and before closure of spaces.

PART 2 - PRODUCTS

2.1 Materials

1. A/D Firebarrier Firestop Systems, by A/D Fire Protection Systems Inc., capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN4-S115 and not to exceed opening sizes for which they are intended.
2. Mineral Wood Backing Insulation: ULC labelled, preformed non-combustible material (A/D Firebarrier Mineral Wool) by A/D Fire Protection Systems Inc.
3. Retainers: Clips to support mineral wool.
4. Firestopping Sealant: ULC labelled, single component silicone bases, A/D Silicone Firebarrier Sealant by A/D Fire Protection Systems Inc.

5. Firestopping Seal: ULC labelled, single component water-base seal, A/D Firebarrier Seal by A/D Fire Protection Systems Inc.
6. Firestopping Foam: ULC labelled, two components silicone foam, A/D Firebarrier RTV Foam by A/D Fire Protection Systems Inc.
7. Firestopping Mortar: ULC labelled, non-combustible fibre reinforced, foamed cement mortar, A/D Firebarrier Mortar by A/D Fire Protection Systems Inc.
8. Damming Material: In accordance with tested assembly being installed as applicable and as acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 Examination

1. Examine surfaces to receive work of this Section and report any defects which may affect the Work of this Section.
2. Verify that openings are ready to receive the Work of this Section.
3. Confirm compatibility of surfaces to receive firestopping and smoke seal materials.
4. Beginning of installation means acceptance of existing surfaces and substrate.

3.2 Preparation

1. Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.
2. Prepare surfaces in contact with firestopping materials and smoke seals to manufacturer's instruction.

3.3 Application

1. Install firestopping and smoke seal material and components in accordance with ULC listing and manufacturer's instructions.
2. Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
3. Apply in sufficient thickness to achieve rating to uniform density and texture.
4. Provide temporary forming if required.
5. Tool or trowel exposed surfaces to a neat finish where required.
6. Remove excess material promptly as work progresses and upon completion.

7. Protect installed material until cured or set.

3.4 Cleaning

1. Clean adjacent surfaces of firestopping and smoke seal materials.

3.5 Field Quality Control

1. Notify Consultant when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

3.6 Scheduling

1. Firestop and smoke seal at:
 - .1 Penetrations through fire separations (rated and non-rated); masonry, concrete, and gypsum board partitions and walls.
 - .2 Top of fire separations (rated and non-rated); masonry and gypsum board partitions.
 - .3 Intersection of fire separation masonry and gypsum board partitions.
 - .4 Control and sway joints in fire separation masonry and gypsum board partitions and walls.
 - .5 Penetrations through fire separation floor slabs, ceilings and roofs, if applicable.
 - .6 Openings and sleeves installed for future use through fire separations.
 - .7 Refer to AD drawings for locations of fire separations.
 - .8 Refer to AD725 for detail of top of wall fire separation assembly.

3.7 Sound Seal

1. At top of all non fire separations masonry partitions compress mineral wool and fill space between masonry and structure. Apply sealant on at least one side of the sound separation.

End of Section

PART 1 - GENERAL

1.1 Scope of Work

1. Work in this section shall include design, fabrication, supply and installation of a custom made, preformed, prefinished, aluminum composite, dry joint modular wall and soffit system, sub girt system, fastening hardware and flashings.

1.2 Related Work

1. Structural Steel Framing
2. Air Vapour Barrier Membrane Section 07112
3. Building Insulation Section 07212

1.3 Quality Assurance

1. Supplier/ installer shall have minimum 10 years proven experience and must have completed at least 5 major projects in the specified aluminum composite material panel system.

1.4 References

1. ASTM A653 "Standard Specification for Sheet Steel, Zinc Coated (Galvanized) by the Hot Dip Process".
2. ASTM B209 Aluminum Sheet and Plate
3. ASTM B221 Extruded Aluminum Shapes.
4. ASTM E283-99 Air Infiltration and Exfiltration.
5. ASTM E331-00 Water Infiltration.
6. ASTM E330-02 Wind Load Resistance

1.5 Design and Performance Requirements

1. Design, fabricate and erect a pressure equalized wall panel system to meet the following requirements.
 - .1 Rain Penetration: prevent rain penetration through wall system. Design system based on "Rain Screen Principle" per the National Research Council. Incorporate means of draining to the exterior.
 - .2 Wind load: Design wall system to resist wind loads, positive and negative, expected in this geographical region (OBC climatic data, 100 years probability) without causing rattling, vibration or excessive deflection of panels, overstressing of fasteners, clips and other detrimental effects on system.

- .3 Structural and thermal movement: Accommodate movement of supporting structural framing and movement caused by thermal expansion and contraction of system component parts without causing bowing, buckling, delamination, oil canning, and failure of joint seals, excessive stress on fasteners or any other detrimental effects.
- 2. Panel flatness tolerance: Fabricate panels not exceeding the following tolerances:
 - .1 Rises and falls across the panel, (local bumps and depressions) will not be accepted.
 - .2 1.5 mm in a concave/ convex direction, measured perpendicular to the normal plane.
- 3. Panel removal: System/ procedure to allow removal of individual panels within wall system.
- 4. Maximum deviation from vertical and horizontal alignment of erected panels: 6 mm in 6 m.
- 5. Testing: Provide wall assembly that has been tested and certified to conform to the following criteria:
 - .1 Structural: Provide systems that have been tested in accordance with ASTM E330 at a design pressure of 60 psf and have been certified to be without permanent deformation or failures of structural members.

1.6 Samples

- 1. Submit samples in accordance with Section 01340.
- 2. Submit duplicate, minimum 130 x 180 mm samples of each colour selected.

1.7 Shop Drawings

- 1. Submit shop drawings in accordance with Section 01340.
- 2. Indicate elevations, profiles, dimensions and thickness of panels and joint details.
- 3. Indicate attachment clips, system extrusions, fastening, anchor and installation details.

1.8 Maintenance Data

- 1. Provide maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manual.

1.9 Mock up

- 1. Submit mock-up in accordance with Section 01340.
- 2. Erect mock-up panel approximately 3m long x 2m high in location as directed by architect.

3. Mock-up panel shall include all components of the wall system and will be incorporated into work once approved.

1.10 Maintenance Data

1. Protect panel face with a plastic film adhered to panel in accordance with panel manufacturer's recommendation.
2. Store components and materials in accordance with panel manufacturer's recommendations.

1.11 Duranar XL Panel Finish Warranty

1. Provide a manufacturer's written warranty: Furnish panel manufacturer's written warranty covering failure of factory-applied exterior finish on composite metal panels within the warranty period; warrant finish per ASTM D 4214 for chalk not in excess of 8 NBS units and fade not in excess of 5 NBS units. Warranty period for finish: 10 years after the date of Substantial Completion.

1.12 Material and Workmanship Warranty

1. Warranty against defects or deficiencies shall be for a period of one year from date of substantial completion.

PART 2 - PRODUCTS

2.1 Panels

1. Aluminum Composite Material (ACM)
 - .1 Composition: Two sheets of aluminum sandwiching a core of extruded thermoplastic formed in a continuous process without the use of glues or adhesives between dissimilar materials. Bond integrity testing to adhere to ASTM D1781-76
 - .2 Aluminum face sheets: Aluminum alloy 3003, thickness: 0.51 mm
 - .3 Panel thickness: 4 mm
 - .4 Panel weight: 5.28 kg/sq.m.
 - .5 Tolerances:
 - .1 Panel bow: Maximum 0.8% of panel dimension (width or length).
 - .2 Panel Dimensions: Take site measurements before proceeding with production unless dimensions can be guaranteed by General Contractor.
 - .3 Panel lines, breaks and angles to be sharp and true; panel surfaces to be free from warp or buckle.
 - .6 Panel System: rout and return dry vented joints, pressure-equalized rainscreen design, with 12.5 mm wide panel joints with splines, using proprietary aluminum extrusions.
 - .7 Acceptable material and manufacturer:
 - .1 Accumet 2000 supplied by Flynn Canada
 - .2 Reynobond ACM supplied by Kanalco Ltd.

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- .3 Alucobond Plus, supplied by Sobotec Ltd.
 - .4 Alpolic ACM, supplied by ACM Panelworx.
 - .5 Alcotex ACM by Ontario Panelization.
2. Panel finish: Duranar XL, three coat, coil-coated finish containing Kynar 500 polyvinylidene fluoride resin. Colours: to consultant's selection. Allow for two (2) different colour selections.
ACM Panel Type-1
3. Panel and Wall Accessories
- .1 Provide proprietary aluminum extrusions to manufacturer's standard profiles for a complete installation.
4. Fasteners: as recommended by panel manufacturer, concealed and non-corrosive. No Exposed fasteners permitted.
5. Extrusions and extrusion clips for attaching panels to the sub-structure: Purpose made aluminum.
6. Extrusions shall be full length around panel perimeter for panel reinforcement and alignment. Intermittent clips are unacceptable.
7. Joint filler strip: Same material and color as panels. Use of caulking at joints is not acceptable.
8. Plastic shims, shall be used as thermal separator between extrusions and sub-girts.
9. Sub-girts: To be manufactured from G-90 galvanized steel and shall be designed to accommodate expansion and contraction, dynamic movements and design load requirements.
10. Flashing: Pre-finished aluminum to match panels.

PART 3 – INSTALLATION EXECUTION

3.1 Panel System

- 1. Before proceeding, examine work of other sections upon which this section depends.
- 2. Erect panels and joint filler strip in accordance with manufacturer's details to meet specified design criteria and performance.
- 3. Finished work shall be securely anchored, free of distortion, free of surface imperfections and uniform in colour.
- 4. Use concealed fastenings only.
- 5. Install panels plumb, true, level and in alignment to established lines and elevations.

3.2 Clean up

1. Remove protective plastic film from panels.
2. Repair and touch-up with colour matching high grade enamel minor surface damage.
3. Replace damaged panels and components which cannot be satisfactorily repaired.

End of Section

PART 1 - GENERAL

1.1 Standards

1. Perform work to applicable standard in:

- Roof membrane manufacturer printed instructions [current edition].
- Canadian Roofing Contractors Association [CRCA] Specification Manual [current edition].
- Ontario Building Code.
- All applicable rules, regulations and directives as established by the local municipality.
- Current requirements of the Ontario Fire Marshall Office.

1.2 References

- CGSB-37-GP-56M / ASTM D6164 / ASTM 6163 - Membrane, Modified, Bituminous, Prefabricated and Reinforced for Roofing.
- CGSB 37-GP-9M / ASTM D41 - Primer, Asphalt for Asphalt Roofing, Dampproofing and Waterproofing.
- CSA 123.4 / Roofing Asphalt
- CAN/ULC-S704 - Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- CAN/ULC-S107 – Fire Test of Roof Covering.
- ASTM E108/ANSI/UL 790–Standard Test Methods for Fire Tests of Roof Coverings.
- CAN/CSA A123.21 – Dynamic Wind Uplift Resistance of Roof Membrane Systems.
- ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- ASTM C1177- Glass Mat Gypsum Substrate for Use as Sheathing.
- ASTM C1278 – Fiber Reinforced Gypsum Panels
- Canadian Roofing Contractors Association (CRCA) – Specification Manual.

1.3 Description

1. Roof System One R1 (from top to bottom)

- .1 Flood Coat and Ballast
- .2 2-ply glass felt membrane
- .3 1-ply Composite Ply felt membrane
- .4 Asphalt Coated Fiberboard Overlay Board
- .5 Insulation (tapered insulation where required)
- .6 Vapour Retarder
- .7 Sheathing Board
- .8 Roof Deck (Section 05310)

1.4 Performance Requirements

1. Work of this section shall:

- Prevent infiltration of outside water into the building and into the roof system through the roofing membrane or membrane flashing.
- Retard the transmission of moisture vapour from the building from passing into the insulation in the roof system.
- Roof system to be tested to CSA 123.1 system.

1.5 Related Work

1. Steel Roof Deck	
2. Rough Carpentry	Section 06110
3. Metal Flashing	Section 07620

1.6 Reference Standards

1. Perform work to applicable standard in:
 - Roof membrane manufacturer printed instructions [current edition].
 - Canadian Roofing Contractors Association [CRCA] Specification Manual current edition].
 - Ontario Building Code.
 - All applicable rules, regulations and directives as established by the local municipality.
 - Current requirements of the Ontario Fire Marshall Office.
 - The project specifications.

1.7 Guarantees and Warranties

1. Roof Membrane Manufacturer Warranty
 - .1 The manufacturer shall issue a non-prorated warranty for a period of Twenty Years. All components including the vapor retarder, insulation, overlay board, membrane, flood coat, perimeter flashings including metal shall be covered under this warranty.
 - .2 Warranty shall include inspections in years 2, 5, 10 and 15 of the warranty. The following duties shall be carried out at no extra cost to the Owner as required, by the Manufacturer.
 - Sealing of flashing seams
 - Filling of pitch pockets
 - Repairs to blisters and ridges
 - Caulking at metal details as required
 - Removal of light debris from the roof and premises
 - Cleaning of drain screens
2. Roofing Contractor's Warranty
 - .1 Provide a written warranty stating that the Contractor will warrant to repair, at its own expense, any actual roof leaks or deficiencies in the roofing membrane, flashing

membrane and related sheet metal work resulting from faulty workman- ship for a period of 2 [two] years on the roofing membrane, flashing membrane and on the related sheet metal work after the effective date of the warranty.

3. The OIRCA standard form of two-year contract will be acceptable for the Roofing Contractor's Warranty.
4. The effective date of the warranties shall be the date of Final Inspection by the Roof Consultant.

1.8 Submittals

1. Prior to the start of work, the contractor shall make all submittals to the Consultant according to section 01 33 00
2. Product Data
 - .1 Submit WHMIS MSDS - Material Safety Data Sheets
 - .2 Submit product data sheets for materials.
Include: Product characteristics.
Performance criteria.
Limitations.
 - .3 A specimen copy of the proposed warranties.
 - .4 Written submission from roof membrane manufacturer stating that the Contractor is an approved applicator of the materials to be used
 - .5 Confirmation that roof system has been tested to CSA A123.21 – Dynamic Wind Uplift Resistance of Roof Membrane Systems for the design required uplift pressures.
3. Shop Drawings
 - .1 Indicate tapered insulation details.
 - .2 Provide layout for tapered insulation.
 - .3 Shop drawings of all proprietary items to be supplied and installed on this project.
4. Samples
 - .1 Membrane samples as may be required

1.9 Workmanship

1. All applications shall be by mechanics skilled in this trade, certified by the roof membrane manufacturer and have a minimum of 5 years experience with the work to be done.
2. Upon completion of the installation, and notification made to the roof membrane manufacturer, The Contractor shall require the manufacturer to perform an inspection in accordance with the Specifications and for the purpose of issuing the required warranty.

3. The Roofing Contractor shall be officially recognized as an approved Contractor of the membrane contractor during the bidding period as well as during the installation.

1.10 Delivery, Storage and Handling of Materials

1. Materials must be delivered and stored according to the directions of the manufacturer and the instructions of the owners representative.
2. All materials shall be stored so that the materials are not in contact with the ground.
3. All materials shall be stored so that they are covered sufficiently to be protected from high winds, heavy rain and other environmental contaminants. Manufacturer wrap may not be sufficiently weatherproof to protect materials.
4. All Materials must be delivered and stored undamaged in original containers with Manufacturers markings, labels, and WHMIS markings intact and legible.
5. All rolled roofing products are to be stored on end, dry, and fully protected from moisture and environmental contamination.
6. All adhesives, caulking, and cements are to be stored protected, and at a temperature above the freezing point.
7. Any materials that are determined, by the Owner's representative or the Consultant, to be damaged or otherwise unsuitable to be installed in the work are to be removed from the job site and replaced immediately at no cost to the Owner.
8. Materials stored on the roof shall not be in contact with the roof and shall be tightly tarped against environmental contaminants. The Contractor shall contact a structural Engineer to determine the loading for storage on the roof deck.
9. Propane tanks shall not be stored on the site overnight or over weekends.

1.11 Protection

1. Cover walls and adjacent work where materials hoisted or used.
2. Use warning signs and barriers. Maintain in good order until completion of work.
3. Clean off drips and smears of bituminous material immediately.
4. Dispose of rain water off substrates and away from face of building until drains or hoppers are installed and connected.
5. Protect roof areas from traffic and damage.

6. Do not remove any more roof membrane that can be made waterproof within the same day with consideration to weather conditions and forecasts.
7. Place plywood runways over work to enable movement of material and other traffic.
8. At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed work and materials out of storage.
9. Install insulation promptly to avoid possibility of condensation beneath vapour retarder.

1.12 Preparation

1. Before commencing work, the contractor will verify that all environmental and site conditions are suitable for installation of material in accordance with Manufacturer's recommendations and requirements. If there is dispute or discrepancy with this requirement the Consultant shall intermediate to resolve the dispute or discrepancy.
2. Assure that substrates are free of voids, faults and/or other deficiencies that would affect the performance of the vapour retarder, insulation, flashing membrane or roof system.
3. All work shall be scheduled and executed without exposing the interior of the building areas to the effects of inclement weather. The existing building and its contents shall be protected against all risks.
4. Commencement of work shall imply acceptance of surfaces, site and all job conditions.

1.13 Working Conditions

1. The Roofing Contractor will be allowed to set up his equipment as close to the work as possible but shall allow the Owner, staff, visitors, and the general public proper and reasonable access to the building. Access to kettle area shall be completely isolated from the public by temporary fencing or the equivalent to the satisfaction of the Owner and the Roof Consultant and any local regulations.
2. The Contractor shall not obstruct duly marked, or otherwise, fire access routes, safety lanes or other emergency access to the building or grounds.
3. The Contractor shall take all necessary precautions as to the protection of grounds, property, vehicles, and persons, of Owner, staff, visitors or the general public. The Contractor will include all costs for the provision or required protection, including but not limited safety barriers at equipment and at sidewalks walkways and roadways.
4. The means and methods of construction are the responsibility of the contractor. It is the contractor's responsibility to ensure equipment used is appropriate for the site conditions and that the equipment is used safely and as it was intended for.

1.14 Field Quality Control

1. Daily inspections are to be carried out throughout the duration of the project.
2. The Roof inspection shall in no way relieve the Roofing Contractor from his responsibilities or obligations under the terms of the Contract or the Contract Documents.
3. Upon completion of the project, a final inspection will be required with the installer, the consultant, and the owners representative.

1.15 Fire Watch

1. The Roofing Contractor shall have one-person stay on site for a minimum of 3 hours after last torch work is done for the day. This person shall patrol and scan the torched areas for signs of smoke or other indications of smoldering or potential fire.

1.16 Pre-Job Site Meeting

1. The Roofing Contractor shall schedule a pre-start site meeting a minimum of two days prior to bringing material on site or starting any work on site. This meeting shall include the General Contractor, Roofing Contractor, Roofing Foreman, Roof Consultant and the Owners representative.

PART 2 - PRODUCTS

2.1 Compatibility

1. Assure that all components of the new roof system are compatible one with each other.
2. Where the new roof is in contact with existing materials, ensure that all components are compatible.
3. Contaminants such as grease, fats, oils, solvents and gasoline shall not be allowed to come in contact with the new roofing membrane.

2.2 Components

1. The components of the Roof System are to be products of the same manufacturer wherever possible,
2. The components of the roof system are as indicated on the detail drawings and specified in the Contract Documents.
3. Components to be used that are other than those specified and manufactured by the accepted manufacturer are to be submitted for review and acceptance by the Roof Consultant.

2.3 Vapour Barrier Support Panels (for use on metal deck)

1. Description : Gypsum-Fiber Roof Board , [12.5 mm thick].
2. In conformance with : ASTM E 84 and ASTM C 1177
3. Specified product : Dens Deck Prime

2.4 Adhesive

1. To adhere sheathing board to roof deck.
2. Description: A highly elastomeric, two components foamable adhesive that can be applied at any temperature and sets in minutes.
3. Standard - Tremco Low Rise Foam Adhesive.

2.5 Vapour Retarder

1. Coated Trilaminate Reinforced SBS modified ply sheet reinforced with a polyester/glass scrim/glass mat reinforcement in conformance with ASTM D 4601, Type II.
2. Standard – Tremco Composite Ply HT.

2.6 Termination Bar

1. Extruded aluminum without sharp edge , purpose made for this application.
2. Profile formed to allow sealant trough at upper edge.

2.7 Asphalt Primer

1. Asphalt primer to CGSB 37-GP-9Ma.
2. Standard – Tremprime WB.

2.8 Flashing Tape

1. To be used as vapour barrier extensions to wall AVB and as tape to prevent asphalt leaks or flame spread.
2. SBS modified self-adhesive flashing tape, sanded surface.
3. Cut to 150mm “6” widths.

2.9 Insulation

1. Closed cell polyisocyanurate foam, manufactured using HCFC free blowing agents and integrally laminated to heavy, fibre reinforced facer.
2. Meets requirements of CAN/ULC-S704 .
3. Insulation boards 1200mm x 1200mm (4'x4').
4. Base Insulation to be two layers $2 \times 3.0" = 6".0"$

5. Standard – Trisotech G by Tremco

2.10 Tapered Insulation

1. Provide premanufactured tapered polyisocyanurate foam board insulation sumps at all roof drains.
2. Insulation sump to at all drains, 2400mm x 2400 mm (8' x 8') . Sump to provide 2% slope to drain.
3. Provide pre-manufactured tapered polyisocyanurate foam board insulation where shown.
4. Taper cut to provide slopes to drain on computer controlled machine, sequence packed with detail instructions. Meets requirements of CAN/ULC-S704 .
5. Crickets and back slope to have minimum 2% slope unless otherwise called out.

2.11 Protection Board

1. BP ESGARD High Density Asphalt Coated (6 sides) Fiberboard Insulation, 0.5" (12.5mm) thick

2.12 Cant Strip

1. Rigid wool fibre cant strip with bitumen saturated sanded surface for mop application.
2. Torch safe 4" triangular support to provide 45 degree transition at supported perimeter.

2.13 Built Up Membrane

1. Three ply built-up conventional asphalt and membrane roof system with an Trilaminare base sheet and 2 ply of fiberglass felt.
2. Base Ply Membrane
 - .1 Coated Trilaminare Reinforced SBS modified ply sheet reinforced with a polyester/glass scrim/glass mat reinforcement in conformance with ASTM D 4601, Type II.
 - .2 Standard – Burmastic Composite Ply HT by Tremco
3. Roofing Felt Ply
 - .1 Roofing felt to be 2 Ply - Type IV asphalt coated fiberglass felts, meeting ASTM D 2178, TYPE IV.

2.14 Membrane Flashings

1. Membrane flashing will be a 1-ply system consisting of Elastomeric Sheeting compounded from a blend of EPDM and SBR thermoset elastomers.
2. Standard – TRA Elastomeric Sheeting by Tremco.

2.15 Roofing Asphalt

1. Insulation, Membrane and Flashing : High Performance SEBS Modified Elastomeric Hot Melt Adhesive exceeding ASTM D 6152.
2. Standard – Thermastic 80 by Tremco.

2.16 Roof Gravel

1. Gravel shall be commercial grade , washed pea gravel
2. 3/8" (10mm) clean and dry pea gravel to ASTM D 1863-66. Minimum 10mm.

2.17 Roof Top Walkways and Splashpads

1. Precast Concrete Pavers: 2' (50mm) x 2' (50mm).
2. Provide walkway protection at roof access points.
3. Provide walkways as shown on roof plan.
4. Provide walkways as splashpads for downspouts and under supports for roof top equipment and gas line supports.

2.18 Roof Drains

1. Roof Drain: Thaler RDX – 30 spun aluminum one piece, shaft and flange, ballast guard and provisions for clearing access. To be supplied under Division 15.

2.19 Vent Stack Flashings – Supplied by Roofer

1. Spun aluminum sleeve and base flange.
2. Separate removable self-sealing cap.
3. Fully insulated.

2.20 Mechanical Electrical Flashing

1. Two piece soldered galvanized box with extended removable cap. Cap to provide weather hood protection of conduit. Mechanical electrical penetration to exit from the side of the flashing box under the removable cap.
2. Fabricate with sufficient space for mechanical electrical conduit or cable as required.
3. Flashing to have fully soldered flange for roof flashing and is to be fully sealed and insulated.

2.21 Primer

1. Asphalt primer to CGSB 37-GP-9Ma.
2. Shall be approved by membrane manufacturer.

2.22 Mastic Sealer

1. High Performance One Part Roof Elastomer formulated from polymers, plasticizers and selected additives.
2. Standard – PolyRoof LV by Tremco

2.23 Sealant

1. Modified polyurethane joint sealant.
2. Shall be approved by adjacent materials manufacturer.
3. Tremco Dymonic or equivalent.

2.24 Plastic Cement

1. High Performance One Part Roof Elastomer formulated from polymers, plasticizers and selected additives.
2. Standard – PolyRoof LV by Tremco.

2.25 Pourable Sealant

1. Pourable urethane no shrink sealer.
2. Standard – Tremseal PP Sealer by Tremco

2.26 Mechanical Electrical Flashing

1. Mechanical/Electrical Flashing: as a standard for acceptance - AMS model MEFA, 12" (305 mm) high c/w Gooseneck Assembly with multiple wire sleeves(
2. Use for all electrical and mechanical penetrations through the roof membrane
3. Where prefabricated flashing is not suitable for the application; a fully soldered site fabricated, insulated box with separate lid to provide hood for side feeding required penetrations. Opening will be sealed to prevent water or insect access.

2.27 B Vents and Tall Cones - supplied by Roofer

1. B-vents and tall cones to be spun aluminum with base flange and adjustable rainskirts.
2. Throat of B Vent to fit pipe penetration. Seal around rainskirt.

2.28 Gas Line Supports – supplied by Division 15

1. Gas line supports to be UV / rubber shell.
2. Include galvanized pipe strap over gas line.
3. Supports to provide adjustable height and manufacturer supplied base or fit tight under gas line.

4. Mop additional one ply of base ply membrane under supports before gravelling. Keep gravel back from under supports.
5. Pipe supports to be designed for the size and type of line supported.
6. Provide supports according to pipe diameter and applicable code requirements.
7. Standard of acceptance C Series supports by C Port.

PART 3 - EXECUTION

3.1 Precautionary Notes

1. The Roofing Contractor shall co-ordinate the installation so that each area is made watertight at the end of each work period.
2. All material is to be installed to meet manufacturer recommendations and printed literature.

3.2 Roof Deck

1. The roof deck shall be smooth, dry, and clean; free of ridges or loose areas and sharp edges. The Roofing Contractor shall ensure that the deck is tight and secure to the underlying frame work prior to starting installation of new roof system. The General Contractor should be notified immediately and in writing of any defects.
2. There shall be no standing water or moisture on the deck. All dust, debris, ice, snow or water shall be removed from the deck.

3.3 Rough Carpentry

1. All curbs, sleepers and bases shall be raised so that the top edge of the curb, sleeper or base is a minimum of 12 inches above the level of the roof.
2. Ensure that all wood blocking has been installed square and secured to roof deck.

3.4 Flashing Tape

1. Apply flashing tape to all joints and around all roof deck penetrations as necessary to protect building interior from potential asphalt dripping.
2. Apply Flashing tape to tie in roof AVB to wall AVB where necessary for compatibility.

3.5 Deck Sheathing – Adhesive

1. Install panels staggered with 4' offset between end joints.
2. Install Dens-Deck Prime to deck with fasteners installed per manufacturer specifications. Apply adhesive in continuous ½" -3/4" ribbons to top of deck flute.
3. Adhesive should be applied at full ribbons maximum spread 12" o.c

3.6 Asphalt Primer

1. Apply asphalt primer to all concrete and masonry surfaces that are to receive applications of hot asphalt.
2. Sheathing board must be primed before application of vapour barrier.
3. Apply primer at manufacturer's application rate and curing instructions.
4. Re-prime all surfaces that become contaminated with dust or marred due to their exposure to roof traffic or weather.

3.7 Vapour Retarder

1. Apply vapour barrier according to manufacturer's specifications.
2. All gaps or cracks in the roof deck, including openings around vent stacks and parapet bases, should be sealed with self-adhesive membrane before vapour barrier is installed.
3. Shingling of the membrane rolls shall begin at the roof drains or the low point of the roof.
4. Lap side joints minimum 3 ½" (inches) 90 mm and end joints 6"(inches) 152 mm. Stagger end joints a minimum of 12" (inches) 304 mm.
5. Install the membrane in Hot Rubberized Asphalt applied at the rate of 25lbs (pounds) per 100 square feet (1.2 kg/m²).
6. No tears, rips or other perforations will be allowed in the vapour retarder. Seal all joints with a torch and a rounded end trowel
7. Vapour retarder shall be sealed with roof cement or sealant at all roof penetrations.
8. Vapour retarder shall be carried to the top of the cant strip; and/or to meet any wall air/vapour barrier as designed unless dictated otherwise by the Consultant.
9. Vapour retarder shall be extended up the vertical surface to surround the edge of the insulation.

3.8 Base Insulation

1. Install Insulation in full and complete mopping of Hot Rubberized Asphalt. 25lbs (pounds) per 100 square feet (1.2 kg/m²).
2. Place insulation in required position with all edges well-fitting to neighboring boards but not putting pressure on other boards.
3. Gaps in insulation greater than 1/4" must be filled with similar insulation material.
4. Insulation boards should be in staggered rows with staggered laps.

3.9 Insulation Cover Board

1. Insulation protection board shall be installed in a full and complete mopping of Hot Rubberized Asphalt 25lbs (pounds) per 100 square feet (1.2kg/m²) in place over base and tapered insulation.

2. Cover board edges shall be staggered against insulation edges and joints shall not line up.
3. Coverboard edges to be butted tight without overlapping each other

3.10 Roof Drains

1. All roof drains shall be set into a layer of plastic cement and reinforced with an additional layer 3'x3' of base sheet.. Flanges of the roof drains shall be primed with a full coat of bitumastic primer and allowed to dry before installation.

3.11 Membrane Base Ply

1. Install Membrane Base ply to manufacturers' instructions.
2. Embed base ply into uniform solid mopping of Hot Rubberized Asphalt, using a nominal 25 lbs per 100 sq ft per ply.
3. Shingling of the roofing plies shall begin at the roof drains or the low point of the roof.
4. Lap side joints minimum 3 ½" (inches) 90 mm and end joints 6"(inches) 152 mm. Stagger end joints a minimum of 12" (inches) 304 mm.
5. All overlap edges to be fully adhered to the membrane beneath. No creases, voids or fishmouths.
6. Reinforce around all projections and drains with an additional layer of base sheet.

3.12 Roofing Membrane

1. Embed 2 plies of specified roofing felt in shingle fashion into uniform solid mopping of Hot Rubberized Asphalt, using a nominal 25 lbs per 100 sq ft per ply.
2. Shingling of the roofing plies shall begin at the roof drains or the low point of the roof perpendicular to the slope.
3. Overlap starter strips 510mm with first ply, each successive roll will overlap 485mm (27").
4. Roofing felt should be rolled in and firmly embedded into the bitumen. During application, embedding may be assured by brooming in the felt after each ply.
5. Any voids or fish-mouths in fiberglass felts must be cut out and covered with a minimum additional two plies mopped in.
6. Roof areas will not be graveled without the approval of the Consultant.

3.13 Membrane Flashing

1. The 3 plies of roofing membrane shall be terminated at the top of the cant strip.
2. The reinforced rubber membrane flashing shall be mopped in place starting 6 inches beyond the toe of the cant, on the field of the roof and extending onto the cant up the vertical, curb, or eaves edge. The flashing membrane shall be terminated; at eh

underside of a reglet; shall be turned down the inside of a curb 1.5 inches; at parapet edges the membrane shall be turned down to cover the fascia.

3. All membrane flashings shall be set into full, even, and uniform mopping of Hot Rubberized Asphalt.
4. Membrane flashings shall be mechanically fastened with round top masonry nails, or round top cap nails depending on whether substrate is masonry or wood.
5. Round top nails shall be 1.5 inches long and shall be galvanized for corrosion resistance.
6. Membrane flashings terminating on a vertical surface shall be secured with termination bar and screws spaced at most 12" o.c and the upper terminus sealed with Mastic.
7. On parapets or walls higher than 15 inches termination bars will be mechanically fastened to the wall or parapet to support and secure the membrane flashing.

3.14 Surfacing

1. Asphalt flood coat for gravel shall be applied at the rate of 2.9 kg/m² (60 lbs. per 100 sq. ft). There shall be no voids or dry spots prior to the application of aggregate. Any non-adhered gravel shall be re-poured.
2. Commercial grade, washed, opaque 10 mm to 16 mm gravel should be used. No more than 10% of any lot should be outside these size requirements.
3. Embed not less than 19.5 kg/m² [400 lbs per 100 sq ft] of gravel into Hot Rubberized Asphalt.

3.15 Sealing

1. Apply sealant to all reglets upon completion of flashings, at the junction of the metal flashing return, and adjacent building members.
2. Apply sealant where shown or required by common good roofing practice.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Metal Decking:	refer to structural drawings
2. Rough Carpentry:	Section 06100
3. Masonry:	Section 04200
4. Air Vapour Barrier Membrane:	Section 07112
5. Built Up Bituminous Roofing:	Section 07510
6. Building Insulation	Section 07212

1.2 Design Criteria

1. Design metal siding system to provide for thermal movement of component materials caused by ambient temperature range of 100 degrees C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
2. Include expansion joints to accommodate movement in wall system and between wall system and building structure, caused by structural movements, without permanent distortion, damage to infills, racking of joints, breakage of seals, or water penetration.
3. Design members to withstand dead load and wind loads calculated in accordance with NBC and applicable local regulations, to maximum allowable deflection of /180th of span.
4. Provide all necessary interior reinforcing girts to withstand all loads as described in item .3.
5. Design wall system to accommodate specified erection tolerances of structure.
6. Maintain following installation tolerances:
 - .1 Maximum variation from plane or location shown on approved shop drawings: 10mm/10m of length and up to 20mm/100m.
 - .2 Maximum offset from true alignment between two adjacent members abutting end to end, in line: 0.75mm.

1.3 Samples

1. Submit duplicate 300 x 300 mm samples of each siding wall system, representative of materials, finishes and colors, in accordance with Section 01340.

1.4 Shop Drawings

1. Submit shop drawings in accordance with Section 01340.
2. Indicate arrangement of sheets and joints, types and locations of fasteners and special shapes and relationship of panels to structural support members or support wall.
3. Clearly detail and indicate locations of all Z clips, J-closures and edge trims.
4. Describe in shop drawing details, suitable accommodation for the removal and joining of future cladding as described in 1.2.7 of this section and on drawings.

1.5 Acceptable Manufacturers

1. Peerless Enterprises or VicWest Steel Inc., Flynn or Agway Metals Inc.

1.6 Extended Warranty

1. Submit a warranty for metal siding system, covering materials and labour and the repair or replacement of defective work, but for five (5) years total.

PART 2 - PRODUCTS

2.1 Materials

1. Prepainted Steel: Galvanized sheet steel minimum 0.76 mm (22 ga) thickness, complying with ASTM A526-80 with Z275 designation for zinc coating. Prepainted in 8000 Series Colour: by Architect from standard colour selection group.
2. Siding and Soffit - VicWest Steel AD300R: locations as per drawings.
3. For copings and flashings, provide prefinished metal 24 gauge thickness, colour from standard colour selection group.
4. Screws: to CSA B35.3-1962, head color same as exterior sheet, dished to CSA B35.3-1962.
5. Powder actuated fasteners: galvanized, peened ballistic point, plastic cap of same color as exterior sheet.
6. Sealants: in accordance with Section 07900, paragraph 2.1.4, colour selected by Architect. Allow for one (1) colour from manufacturers full range to match adjacent metal.
7. Gaskets: soft pliable arctic grade vinyl, extruded profile.
8. Touch-up paint: as recommended by panel manufacturer and Baycoat, compatible with prefinished coating.

9. Isolation coating: alkali resistant bituminous paint or epoxy resin solution.
10. Insulation: Spray Foam Insulation.

2.2 Components

1. Exterior sheet: factory preformed coated metal, to profiles and thicknesses as indicated.
2. Exterior corners: of same profile, material and finish as adjacent siding material, shop cut and brake formed to required angle, concealed corner brace, hairline exposed joint, pop rivet connections with painted head to match siding.
3. Exposed joint ends of siding sheet shop cut clean and square, backed with tight fitting filler lapping back if joint, exposed components color matched to siding.
4. Accessories: cap flashings, drip flashings, internal corner flashings, copings and closures for head, jamb, eaves, soffits sill and corners, of same material and finish as exterior siding, brake formed to shape. Exposed cut edges of metal profiles will not be accepted.
5. Sub-girts: zinc coated to ASTM A525-78a, G90 coating designation, profile as indicated to accept exterior sheet with structural attachment to building frame.

PART 3 - EXECUTION

3.1 Preparation

1. Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.

3.2 Installation

1. Install sub-girts to masonry walls through air vapour barrier membrane.
2. Install exterior finish siding to internal sub-girts with concealed fasteners.
3. Install insulation using adhesive and ensure a continuous thermal barrier.
4. Provide notched and formed closures, sealed to arrest direct weather penetration at vertical profiles for exterior siding. Ensure continuity of "pressure equalization" of rain screen principle.
5. Provide alignment bars, brackets, clips, inserts, shims as required to securely and permanently fasten wall system to building structure.
6. Supply and install flashing at connection between roof and preformed metal siding.

3.3 Control Joints

1. Construct control joints, as indicated.
2. Use cover sheets, of brake formed profile, of same material and finish as adjacent material.
3. Use mechanical fasteners to secure sheet Expansion Joints materials.
4. Assemble and secure wall system to structural frame so stresses on sealants are within manufacturer's recommended limits.

3.4 Cleaning

1. Wash down exposed surfaces using solution of mild domestic detergent in warm water, applied with soft clean wiping cloths.
2. Remove excess sealant with recommended solvent.

End of Section

PART 1 - GENERAL

1.1 Section Includes

1. This Section includes for provision of all labour, materials, equipment and services for sheet metal flashing and trim Work in accordance with Contract Documents.

1.2 Related Sections

1. Section 06110 Rough Carpentry for Roofing
2. Section 07510 Built Up Bituminous Roofing
3. Section 07901 Joint Sealers for Roofing

1.3 References

1. ASTM A653M- Sheet Steel, Zinc Coated (Galvanized) by the Hot Dipped Process, General Requirements.
2. CAN/CGSB 37-GP-9M / ASTM D41- Asphalt Primer.
3. Canadian Sheet Steel Building Institute (CSSBI) Bulletin No. SSF-3, Core and Maintenance of Pre-finished Sheet Steel Building Products.
4. Canadian Roofing Contractors Specification Manual- 'FL' Series Details.
5. SMACNA Architectural Sheet Metal Quality Assurance Manual - 2015

1.4 Operations

1. Perform operations, at times designated by the *Owner*, that will not adversely affect occupants of building and operations in and around site access and egress.

1.5 Protection

1. Protect work of this section from damage. Damaged work which cannot be satisfactorily repaired, restored or cleaned, shall be replaced at no cost to *Owner*.

1.6 Submittals

1. Submit samples of flashing and sheet metal type and colour to *Consultant* and *Owner* for review prior to commencing work.

1.7 Mock-Up

1. Locate mock-ups at specific areas designated by *Consultant*.
2. Fabricate mock-ups in minimum 2440 mm (8 ft.) lengths with reviewed materials, approved methods including, joints, seams, expansion joints, starter strips and fasteners.

3. Mock-up, if accepted, shall represent the minimum standard for work. Mock-up may be included as part of final work.

1.8 Quality Assurance

1. Flashing and Sheet Metal Work shall be executed in accordance with SMACNA Architectural Sheet Metal Quality Assurance Manual - 2015 by skilled trades having a minimum of five (5) years related experience.

1.9 Warranty

1. Provide minimum two (2) year Warranty from date of Substantial Performance, as certified by *Consultant*. Warranty shall be submitted against defects in workmanship and materials.
2. *Contractor* must extend the Warranty on replaced parts and workmanship for a period of two (2) years from date of acceptance of replacement parts and workmanship. Defects will include but will not be limited to leaking, failure to stay in place, lifting, deformation and breaking of weathertight seals.
3. Provide all additional Warranties that may be available from manufacturer.

Part 2 - PRODUCTS

2.1 Material

1. Prefinished Steel Sheet: Galvanized steel, 0.71 mm (24 gauge) core nominal thickness, zinc coated (galvanized) to designation G90 by the hot dip process, with a prefinished coat. Profiles as detailed.
2. Pre-finished Coat and Primer: 8,000 series finish, factory applied coating on high grade primer. Colour to be approved by Consultant/Owner selected from standard colours listed in General Colour Card.
3. Starter (Hook) Strips: Fabricated from prefinished steel sheet, 0.87 mm (22 gauge) core nominal thickness. Minimum 100 mm (4 in.) wide face **or as detailed** and shall extend onto wall substrate minimum 38 mm (1-1/2 in.) and be continuous.
4. Termination Bar: 3 mm x 25 mm (1/8 x 1 in.) extruded aluminum bar.
5. Fasteners: In accordance with Section 06 10 00 – Rough Carpentry.
6. Touch-up paint: As supplied and recommended by sheet steel manufacturer.
7. Exposed Sheet Metal Fasteners: Self-Drilling Hex Head with washer and colour coded cap.
8. Cap, Counter and Fascia Metal to be fabricated to layouts and details shown on drawings and to extent required.

9. Overflow Scuppers: Overflow (Where Shown on Drawings): Fabricated from 0.71 mm (24 gauge) stainless steel. To be a minimum 203 mm wide x 104 mm high (8 x 4 in.) with continuously soldered seams with a 152 mm (6 in.) wide apron/flanges. Bottom edge to extend 38 mm (1-1/2 in.) past wall and top edge 25 mm (1 in.) with open end.
10. Sealants: In accordance with Section 07 92 00 – Joint Sealer.

Part 3 - EXECUTION

3.1 Fabrication

1. Shop fabricate flashing, sheet metal and trim in accordance with requirements of SMACNA and the Contract Documents. Form sheet metal on bending brake, shaping, trimming and hand seaming on bench.
2. Fabricate cap flashings, counter flashings, closures, starter strips, and other miscellaneous sheet metal work with prefinished sheet metal in general accordance with applicable CRCA 'FL' series specifications and / or as indicated on Drawings.
3. Form sections square, true, and accurate to size. Flashings shall be free from distortion, oil canning, twists, buckles, discolouration and other defects detrimental to appearance and performance.
4. Double back all edges a minimum of 13 mm (1/2 in.).
5. Form joints with S-locks and make allowances for movement. Mitre and form standing seams at all corners. Make allowance for movement at joints.
6. Provide a counter flashing and an intermediate vertical flashing where the cap flashing is greater than 610 mm (24") above the top of the roofing membrane. Form vertical flashings in 1220 mm (4 ft.) maximum lengths.
7. Fabricate cap flashings, counter flashings and starter strips to details shown and where required.
8. Fabricate metal in 2400 mm (8 ft.) maximum lengths with an unbroken face less than 225 mm (9 in.). Form flashings with an exposed unbroken face exceeding 225 mm (9 in.) and a girth greater than 610 mm (24 in.) in 1220 mm (4 ft.) maximum lengths.
9. **Provide horizontal stiffening rib "V" on all face metal exceeding 225 mm (9 in.) in girth and where shown on drawings.**
10. Provide an 'S-Lock' joint at all end joints and at all horizontal joints between the cap flashing and the vertical flashing and between the vertical flashing and base counter flashing.

11. Where soldered joints are absolutely necessary and where approved for use in prepainted metal, clean paint off both surfaces before soldering for minimum area necessary.
12. Sheet metal coming in contact with a metal of a different type must be back painted with two (2) coats of isolation coating.

3.2 Sheet Metal Flashing and Trim

1. Provide a continuous starter strip for all metal cap and counter flashings and gravel stops secured at a maximum 406 mm (16 in.) on centre in a zig-zag-pattern.
2. Install flashings and sheet metal that includes but not limited to; cap flashings, counter flashings, curb and sleeper counter flashings, starter strips and other miscellaneous trim work in accordance with Contract Documents.
3. Parapet and perimeter cap flashings shall be installed with a **minimum 10% positive slope** to interior of roof. Slope to be provided by installation of continuous wood shims, plywood and wood blockings as detailed and in accordance with Section 06 10 00 – Rough Carpentry.
4. Saw cut new reglet or re-use existing (where approved by *Consultant*), into masonry surfaces to accommodate installation of sheet metal flashings. Reglet is to be a minimum 19 mm wide x 25 mm deep (3/4 in. x 1 in.).
5. Install sheet metal work with concealed fasteners. Install exposed fasteners only when and where permitted by *Consultant*. Install fasteners in an approved manner as to prevent water penetration at point of fastening and to be evenly and neatly distributed. Provide fasteners with washers.
6. At reglets, return top edge of flashings into reglet 25 mm (1 in.). Secure flashings with pin grips, spaced at maximum 406 mm (16 in.) on centre and apply sealant bead to shed water.
7. Provide continuous termination bar at top edge of membrane flashings where indicated on Drawings and at locations where membrane flashings terminate at base of a wall and no other means of mechanical securement is specified or indicated. Fasten termination bar to substrate at a maximum 305 mm (12 in.) on centre with appropriate fasteners.
8. Fasteners are to be located a minimum of 305 mm (12 in.) above roof membrane – where possible.
9. End joints of adjacent lengths shall be completed using 'S-Lock' joints. This shall be accomplished by inserting the end of one length in a 25 mm (1 in.) deep "S" lock formed in the end of the adjacent length. Concealed portion of the "S" lock shall extend 25 mm (1 in.) outwards and shall be nailed to substrate. Face nailing of joints will not be permitted.
10. Top edge of counter flashing shall be inserted under cap flashings.

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11. Provide three exposed fasteners on interior side of cap flashing, evenly spaced per 2400 mm (8 ft.) length.

3.3 Overflow Scuppers

1. Where indicated on drawings, install new scuppers and secure to substrate.
2. Flash in scupper flanges in accordance with appropriate roof section.

3.4 Clean-up

1. Remove all excess materials, debris, tools and equipment as work proceeds and on completion, or sooner if requested by *Consultant*.

End of Section

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

1. Joint Sealers for Roofing	:	Section 07901
2. Aluminum Windows and Doors	:	Section 08520

1.2 Environmental Conditions

1. Sealant and substrata materials to be minimum 5 deg. C.
2. Should it become necessary to apply sealants below 5 deg. C, consult sealant manufacturer and follow their recommendations.

1.3 Warranty

1. Contractor hereby warrants that caulking work will not leak, crack, crumble, melt, shrink, run lose adhesion or stain adjacent surfaces in accordance with General Conditions, but for five (5) years total.

PART 2 - PRODUCTS

2.1 Materials

1. Primers: type recommended by sealant manufacturer.
2. Joint Fillers:
 - .1 General: compatible with primers and sealants, outsized 30 to 50%.
 - .2 Polyethylene, urethane, neoprene or vinyl: extruded closed cell foam, Shore A hardness 20, tensile strength 140 to 200 kPa.
 - .3 Neoprene or butyl rubber: round solid rod, Shore A hardness 70.
 - .4 Polyvinyl chloride or neoprene: extruded tubing with 6 mm minimum thick walls.
 - .5 Bond breaker: pressure sensitive plastic tape which will not bond to sealants.
 - .6 Sealant Type A: One component, chemical curing, conforming to CAN2-19.13-M82, Class C-2-25-B-N; multi-component, chemical curing, conforming to CAN2-19.24-M80, Type 2, Class B.
 - .7 Sealant Type B: Multi-component, chemical curing mildew resistant conforming to CGSB 19-GP-22M.
 - .8 Sealant type C: Multi-component, acrylic emulsion base, conforming to CGSB 19-GP-17M.
 - .9 Sealant type D: One component, polyurethane base, chemical curing, conforming to CAN2-19.13-M82, Class C-1-25-B-N; or multi-component, chemical curing, conforming to CAN2-19.24-M80, type 1.
3. Color of Sealants: to be selected by Consultant. Allow for a total of three (3) colours for Type A, two colours for Type B, two colours for Type C and one colour for Type D. Locations as directed on site by Consultant.

4. Joint cleaner: xylol, methylethyl-ketone or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.
5. Vent tubing: 6 mm inside diameter extruded polyvinyl chloride tubing.

PART 3 - EXECUTION

3.1 New Work

1. Caulk where specified in 3.4 and everywhere required.
2. Remove dust, paint, loose mortar and other foreign matter. Dry joint surfaces.
3. Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.
4. Remove oil, grease and other coatings from non-ferrous metals with joint cleaner.
5. Prepare concrete, masonry, glazed and vitreous surfaces to sealant manufacturer's instructions.
6. Examine joint sizes and correct to achieve depth ratio 1/2 of joint width with minimum width and depth of 6 mm, maximum width 25 mm.
7. Install joint filler to achieve correct joint depth.
8. Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
9. Apply bond breaker tape where required to manufacturer's instructions.
10. Prime sides of joints to sealant manufacturer's instructions immediately prior to caulking.

3.2 Application

1. Apply sealants, primers, joint fillers, bond breakers, to manufacturer's instructions. Apply sealant using gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.
2. Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities. Neatly tool surface to a slight concave joint.
3. In masonry cavity construction, vent caulked joints from cavity to 3 mm beyond external face of wall by inserting vent tubing at bottom of each joint and maximum to 1500 mm o.c. vertically. Position tube to drain to exterior.
4. In precast concrete panel facing, vent space behind panels by inserting vent tubing at bottom of each vertical caulked joint and at every second intersection of horizontal and vertical joints. Position tube to drain to exterior.

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5. Clean adjacent surfaces immediately and leave work neat and clean. Remove excess sealant and droppings using recommended cleaners as work progresses. Remove masking after tooling of joints.

6. Use sealants specified in the following locations:

Type A: Joints between windows or door frames and adjacent building components; control and expansion joints and all other locations where sealing is required, except in locations designated for Type B, C and D. Ensure that sealant chosen (from the several specified under "MATERIALS") for each location is recommended by manufacturer for use on surfaces encountered.

Type B: Joints between splash backs and walls.

Type C: Joints between interior metal door frames and partitions.

Type D: Joints in horizontal surfaces between concrete slabs, pavers and precast concrete panels.

End of Section

1. GENERAL

1.1 Section Includes

1. Section includes for provision of all labour, materials, equipment and services for joint sealers in accordance with Contract Documents.

1.2 Related Sections

1. Section 06110 Rough Carpentry for Roofing
2. Section 07510 Built Up Bituminous Roofing
3. Section 07620 Sheet Metal Flashing and Trim

1.3 References

1. Sealants acceptable for use on this project must be listed on CGSB Qualified Products List issued by CGSB Qualifications Board for Joint Sealant.
2. CAN/CGSB-19.24 - Multi-Component, chemical curing sealing compound.
3. CAN/CGSB-19.13 - Single Component, elastomeric, chemical curing sealing compound.
4. CGSB 19-GP-14 - Sealing Compound, One-Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
5. CAN/ULC-S115-05 Standard Method of Fire Tests of Firestop Systems.
6. ULC List of Equipment and Materials, Firestop Systems and Components.

1.4 Operations

1. Perform operations, at times designated by the *Owner*, that will not adversely affect occupants of building and operations in and around site access and egress.

1.5 Protection

1. Protect work of this section from damage. Damaged work which cannot be satisfactorily repaired, restored or cleaned, shall be replaced at no cost to *Owner*.

1.6 Submittals

1. Submit samples of sealant type and colour to *Consultant* and *Owner* for review prior to commencing work.

1.7 Quality Assurance

1. Skilled trades with minimum five years related experience shall execute Work.

1.8 Mock-Up

1. Construct mock-up to show location, size, shape and depth of joints complete with back-up material, primer, sealant and tooling. Mock-up may be included as part of finished work.

1.9 Warranty

1. Provide minimum two (2) year Warranty from date of Substantial Performance, as certified by *Consultant*. Guarantee shall be submitted against defects in workmanship and materials.
2. *Contractor* must extend Warranty on replaced parts and workmanship for a period of two (2) years from date of acceptance of replacement parts and workmanship. Defects will include but will not be limited to; joint leakage, hardening, cracking, crumbling, melting, bubbling, shrinkage, running, sagging, change of colour, loss of adhesion, loss of cohesion and staining of adjoining or adjacent materials on surfaces.
3. Provide all additional Warranties that may be available from manufacturer.

1.10 Environmental Requirements

1. Conform to manufacturer's recommended temperatures, relative humidity and substrate moisture content for application and curing of sealants.
2. Materials must be stored at minimum of 20°C (68°F) immediately prior to application. Sealant applications must be carried out when ambient temperature is above 0°C (32°F).

2. PRODUCTS

2.1 Material

1. All materials in a sealant system shall be compatible with each other and with substrate.
2. Colour(s) of sealants shall be selected to match adjacent substrate and shall be approved by *Consultant* or *Owner*.
3. Elastomeric Sealants: One part elastomeric, non-sag urethane based sealant, for masonry to masonry, masonry to metal junctions. Acceptable Material:
 1. Dymonic as manufactured by Tremco Incorporated.
 2. Vertical Wall Joints - Three-component, chemically curing, epoxidized polyurethane sealant, 'Dymeric 240' by Tremco Incorporated.

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4. Silicone sealants: Silicone based sealant, for metal to metal junctions and glazing. Acceptable Material:
 1. Spectrum 2 as manufactured by Tremco Incorporated.
 2. Dow Corning 999-A Silicone Building & Glazing Sealant by Dow Corning Canada Inc.
 5. Butyl sealants: Butyl rubber and polyisobutylene blend sealant. Butyl sealant to be compatible with modified bituminous membrane flashings. Acceptable Material:
 1. Tremco Butyl Sealant as manufactured by Tremco Incorporated.
 2. Modified Membrane manufacturer's approved sealant.
 6. Firestop Sealant: By Tremco, Dow Corning Canada Inc., GE Silicone, 3M Corporation or approved equal, to CAN/ULC-S115-05.
 7. Joint Backing: Polyethylene, urethane, neoprene or vinyl, extruded foam recommended by sealant manufacturer. Circular shape with diameter 25% greater than joint width before installation.
 8. Primer: As recommended by sealant manufacturer to assure adhesion of compound and to prevent staining of substrate materials.
 9. Joint Cleaner: Non-corrosive and non-staining type, compatible with joint forming materials and sealant as recommended by sealant manufacturer.
 10. Bond Breaker Tape: Polyethylene bond breaker tape, which will not bond to sealant.

3. EXECUTION

3.1 Removal of Existing Sealants

1. Remove existing sealants, backing material, dust, oil, grease, oxidation, millscale, coatings and all other loose material by cutting, brushing, scrubbing, scraping and grinding.
2. Rake out joints, cracks and crevices to receive sealant, to a depth measuring half the joint width. Clean out existing reglets to satisfaction of *Consultant*.

3.2 Preparation

1. Examine joint sizes and conditions to establish correct depth to width ratio for joint backing and sealant. Clean joint surfaces of deleterious material and substances including dust, rust, oil grease, and other matter that may impair work.
2. Ensure joint surfaces are dry and frost free. Prepare substrate as recommended by sealant manufacturer ensuring adjacent surfaces are not damaged.

3. Commencement of Work implies acceptance of existing conditions and assuming full responsibility for finished condition of the Work.

3.3 Priming

1. To prevent staining, mask adjacent surfaces prior to priming and caulking.
2. Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.
3. Prime copper, concrete and masonry surfaces to receive sealant.

3.4 Application

1. Install joint backing all joints prior to applying sealants. Diameter of backing material shall be 25% more than width of joint.
2. **Maintain minimum 2:1 width to depth ratio for sealant.**
3. Apply bond breaker tape where joints are of insufficient size to install joint backing or at 90° junctions or where required by sealant manufacturer or *Consultant*. Ensure bond surface area meets the minimum required size recommended by sealant manufacturer.
4. Where required, mix materials in strict accordance with sealant manufacturer's instructions. Apply sealant using appropriate gun with proper size nozzle.
5. Apply sealant in continuous beads, in solid contact to underlying surfaces with sufficient pressure to fill voids and joints solid.
6. Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets and embedded impurities. Superficial skin bead is not acceptable.
7. Tool exposed surfaces before skinning occurs to attain concave shape using approved tools.
8. Cure sealant in accordance with the manufacturer's requirements. Do not cover up sealants until proper curing has taken place.

3.5 Clean-up

1. Clean adjacent surfaces immediately and leave work neat and clean.
2. Remove excess and droppings using recommended cleaners as work progresses.
3. Remove bonding tape after initial set of sealant.
4. Remove all excess material, debris, tools and equipment as work proceeds and on completion, or sooner if requested by *Consultant*.

End of Section

PART 1 - GENERAL

1.1 Work Included

1. A single manufacturer shall fabricate products included within the scope of this Section.
2. Manufacturer shall be a member in good standing of the Canadian Steel Door Manufacturers Association (CSDMA).
3. Supply only of steel frame products including frames, transom frames, sidelight and window assemblies with provision for glazed, paneled or louvered openings, fire labeled and non-labeled, as scheduled or detailed by the Architect.
4. Supply only of flush steel doors with provision for glazed, paneled or louvered openings, insulated and un-insulated, fire labeled, with or without temperature rise ratings and non-labeled, as scheduled or detailed by the Architect.
5. Supply only of steel panels, similar in construction to steel doors, with flush or abetted bottoms for steel frames, transom frames, sidelight and window assemblies, fire labeled and non-labeled, as scheduled or detailed by the Architect.
6. Doors and frames shall be prepared for, but not limited to, preparation for continuous hinges, heavy weight hinges, cylindrical locks, rim and concealed vertical rod/ mortise lock case exit devices, surface door closers and concealed overhead stops.

1.2 Related Work

1. Building-in of frame product into unit masonry, previously placed concrete, structural or steel or wood stud walls.
2. Supply and installation of wood, plastic or composite core doors.
3. Supply and installation of builders' hardware except as specified for acoustic assemblies.
4. Drilling and tapping for surface mounted or non-templated builders' hardware.
5. Caulking of joints between frame product and other building components.
6. Supply and installation of gaskets or weather-strip.
7. Supply and installation of louvers or vents.
8. Supply and installation of glazing materials.
9. Site touch-up and painting.
10. Wiring for electronic or electric hardware.
11. Field measurements.

12. Fasteners for frame product in previously placed concrete, masonry or structural steel.
13. Steel lintels, posts, columns or other load-bearing elements.
14. Field welding.

1.3 Requirements of regulatory agencies

1. Install fire labeled steel door and frame product in accordance with NFPA-80, current edition, unless specified otherwise.

1.4 References

1. ANSI A115.1G-1994 Installation Guide for Doors and Hardware
2. ANSI A250.4-1994 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings.
3. ASTM A653-M97 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. ASTM A924-M97 Standard Specification for General Requirements for Sheet, Metallic-Coated by the Hot-Dip Process.
5. ASTM B117-95 Method of Salt Spray (Fog) Testing.
6. ASTM C177-97 Test Method for Steady-State heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
7. ASTM C518-91 Test method for Steady State Heat Flux Measurements and Thermal Transmission properties by means of the heat Flow Meter Apparatus.
8. ASTM C578-95 Specification for Rigid, Cellular polystyrene Thermal Insulation.
9. ASTM C665-95 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
10. ASTM D1735-92 Practice for Testing Water Resistance of Coating Using Water Fog Apparatus.
11. CAN4-S104-M80 Fire Tests of Door Assemblies.
12. CAN4-S105-M85 Standard Specification for Fire Door Frames Meeting the performance required by CAN4-S104.
13. CAN4-S106-M80 Standard Method for Fire Tests of Window and Glass Block Assemblies.

14. CGSB 41-Gp-19Ma Rigid Vinyl Extrusions for Windows and Doors
15. CGSB 82.5-M88 Insulated Steel Doors.
16. CSA A101-M83 Mineral Fiber Thermal insulation for Buildings.
17. CSA W59-M89 Welded Steel Construction (Metal Arc Welding)
18. ISO 9001:1994 Quality Systems – Model for Quality Assurance.
19. NFPA-80, 1999 Fire Doors and Windows
20. CSDMA Dimensional Standards for Commercial Steel Doors and Frames.
21. Manufacturers Standard and Galvanized Sheet Gauges
22. Fleming Fire Labeling Specifications
23. ULC List of Equipment and Materials, Volume 2

1.5 Testing and Performance

1. Door constructions covered by this specification shall be certified as meeting Level “A” (1,000,000 cycles) and Twist Test Acceptance Criteria (deflection not to exceed 6.4 mm /13.6kg force, total deflection at 136.1kg force not to exceed 63.5 mm and permanent deflection not to exceed 3.2 mm) when tested in strict conformance with ANSI-A250.4-1994. Test shall be conducted by an independent nationally recognized accredited laboratory.
2. Fire labeled product shall be provided for those openings requiring fire protection and temperature rise ratings, as determined and scheduled by the Architect. Doors, frames, transom frames and sidelight assemblies shall be tested in strict accordance with CAN4-S106. Product shall be listed by Underwriters Laboratories of Canada under an active Factory Inspection Program and shall be constructed as detailed in Follow-Up Service procedures issued to the manufacturer.
3. Should any door or frame specified by the Architect to be fire rated, not qualify for labeling due to design, hardware, glazing or any other reason, the Architect shall be so advised before manufacturing commences.
4. Core materials for exterior doors shall attain a thermal resistance rating of RSI 1.06 (R6.0) when tested in accordance with ASTM C177 or ASTM C518.
5. Product shall be manufactured by a firm experienced in the design and production of standard and custom commercial steel door and frame assemblies, the integration of builders’ or electronic hardware and glazing materials and their impact on the scope of work.

6. Manufacturer shall be assessed and registered as meeting the requirements of Quality Systems under ISO 9001.
7. Product quality shall meet standards set by the Canadian Steel Door Manufacturers Association.

1.6 Test Reports

1. All alternates to this specification shall be submitted to the Architect for acceptance ten (10) days prior to bid date, complete with test reports from independent, nationally recognized testing authorities, certifying that:
 - .1 Steel door and frame assemblies furnished under this section meet the acceptance criteria of ANSI-A250.4-1994, Level "A".
 - .2 Insulated door cores furnished in exterior doors under this Section meet the specified thermal resistance rating.
2. All reports shall include name of testing authority, date of test, location of test facility, descriptions of test specimens, procedures used in testing and indicate compliance with acceptance criteria of the test.

1.7 Submittals

1. Submit shop drawings in accordance with the General Conditions of the Contract.
2. Indicate each type of door, frame, steel, core, material thickness, mortises, reinforcements, anchorages, locations of exposed fasteners, openings (glazed, paneled or louvered) and arrangement of standard builders' hardware.
3. Include a schedule identifying each unit, with door marks or numbers referencing the numbering in Architect's schedules or drawings.
4. Provide confirmation in writing that all aspects to reinforcing, construction, and gauge of metal are met as written in this section.

1.8 Warranty

1. All steel door and frame product shall be warranted from defects in workmanship for a period of one (1) year from date of shipment.
2. All steel door and frame product shall be warranted against rust perforation for a period of five (5) years when the installed and finish painted with a commercial quality paint to the manufacturers recommendations.
3. Finish paint adhesion on all door and frame product shall be warranted for a period of five (5) years when the product has been properly cleaned and finish painted with a commercial quality paint applied as recommended by the paint manufacturer. This warranty shall not exceed that provided by the paint manufacturer.

PART 2 - PRODUCTS

2.1 Doors

1. Materials

- .1 Doors shall be fabricated from tension leveled steel to ASTM A924-M97, galvanized to ASTM A653-M97, Commercial Steel (CS), Type B, coating designation ZF75, known commercially as paintable Galvanneal.
- .2 Door Cores:
 - Honeycomb:
Structural small cell (25.4 mm maximum) kraft paper “honeycomb”. Weight: 36.3 kg per ream (minimum), density: 16.5 kg/m³ (minimum), sanded to the required thickness.
 - .1 Polystyrene:
Rigid extruded, fire retardant, closed cell board, density 16kg/m², thermal values: RSI 1.06 minimum, conforming to ASTM C578.
 - .2 Temperature Rise Rated (TRR):
Solid slab core of non-combustible, inorganic composite to limit temperature rise on the “unexposed” side of door to 250°C at 30 or 60 minutes, as required by governing building code requirements and determined and scheduled by the Architect.
- .3 Adhesives:
 - .1 Honeycomb Cores and Steel Components:
Heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement or ULC approved equivalent.
 - .2 Interlocking Edge Seams:
Resin reinforced polychloroprene (RRPC), fire resistant, high viscosity, sealant/adhesive or UL approved equivalent.
 - .3 Polystyrene Cores:
Heat resistant, epoxy based, low viscosity, contact cement.
- 4. Primer:
Rust inhibitive touch-up only.
- 5. Exterior Top Caps:
Rigid polyvinylchloride (PVC) extrusion.

2. Construction

- .1 General:
 - .1 This section is based on doors and frames as manufactured by Fleming. Doors and frames by other manufacturers are acceptable subject to be similar to the one specified and meeting the terms of this section.
 - .2 Doors shall be swinging, 44.4 mm thick of the types and sizes indicated on the schedules or drawings.
 - .3 Exterior doors shall be lock seam, flush.
 - .4 Face sheets for exterior doors shall be fabricated from (16) gauge steel.
 - .5 Longitudinal edges of exterior doors shall be mechanically interlocked, fully welded, ground smooth with no visible seams. Do not fill seams.

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- .6 Face sheets of interior doors shall be fabricated from 18 gauge steel, except for heavy traffic doors (noted **HT** in Door Schedule) face sheet to be 16 gauge. **Note HT at all interior and exterior exit stair doors at both levels.**
 - .7 Longitudinal edge of heavy traffic doors (noted **HT** in Door Schedule) shall be mechanically interlocked, fully welded, ground smooth with no visible seams. Do not fill seams.
 - .8 Interior doors shall be stiffened, insulated and sound deadened with honeycomb core laminated under pressure to each face sheet.
 - .9 Stiffened, insulated and sound deadened with core where Temperature Rise Rated (TRR) fire labeled doors are specified.
 - .10 Longitudinal edges of interior doors shall be mechanically interlocked, adhesive assisted with edge seams visible.
 - .11 Door faces of all steel doors shall be fabricated without visible seams, free of scale, pitting, coil brakes, buckles and waves.
 - .12 Formed edges shall be true and straight with a minimum radius for the thickness of steel used.
 - .13 Lock and hinge edges shall be beveled 3 mm in 50 mm unless builders' hardware or door swing dictates otherwise.
 - .14 Top and bottom of doors shall be provided with inverted, recessed, 16 gauge steel end channels, welded to each face sheet at 150 mm on center maximum.
 - .15 Exterior doors shall be provided with factory installed flush PVC top caps. Fire labeled exterior doors shall be provided with factory installed flush steel top caps.
 - .16 Unless ineligible due to design, size, hardware or glazing specified on the Architects' or hardware Suppliers' schedules or details, fire labeled doors shall be provided for those openings requiring fire protection ratings and temperature rise ratings, as determined and scheduled by the Architect.
 - .17 Exterior doors shall be internally reinforced with 20 gauge continuous; interlocking steel stiffeners at 150mm O.C. max, with voids between stiffeners filled and insulated with 24kg/m³ density loose batt type fiberglass material to suit fully welded design.
- .2 Hardware Preparations:**
- .1 Doors shall be factory blanked, reinforced, drilled and tapped for fully templated mortised hardware only, in accordance with the final approved schedule and templates provided by the hardware supplier.
 - .2 Doors shall be factory blanked and reinforced only for mortised hardware that is not fully templated.
 - .3 Doors shall be factory reinforced only for surface mounted hardware.
 - .4 Templated holes 12.7mm diameter and larger shall be factory prepared, except mounting and through bolt holes, which shall be by the contractor responsible for installation on site, at the time of application. Templated holes less than 12.7mm diameter shall be factory prepared only when required for the function of the device (for knobs, levers, cylinders, thumb or turn pieces) or when these holes over-lap function holes.
 - .5 Drilling and tapping for surface mounted hardware or mortised hardware that is not fully templated shall be by the contractor responsible for installation on site, at the time of application.

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- .6 Hinge and pivot reinforcements shall be 10 gauge steel minimum high frequency type reinforcing.
 - .7 Hinge reinforcements for acoustic doors and doors in excess of 2450mm rabbet height shall be 10 gauge minimum with each cutout provided with 114.3mm heavy weight (4.6mm) high frequency type.
 - .8 Lock, strike and flush bolt reinforcements shall be 12 gauge steel minimum.
 - .9 Reinforcements for concealed closers and holders shall be 12 gauge steel minimum.
 - .10 For surface mounted hardware, reinforcements shall be 16 gauge steel minimum.
 - .11 All pairs of fire labeled doors shall be provided with 12 gauge steel surface mounted flat bar astragal, shipped loose for application on site, by the contractor responsible for installation.
 - .12 Pairs of doors up to 2450mm x 2450mm, to 1½ hour fire rating maximum shall be provided without astragals. Lock edge seam of such doors shall be tacked-welded and ground smooth. All other fire labeled pairs shall be provided with 12 gauge steel surface mounted flat bar astragal, shipped loose for application on site, by the contractor responsible for installation.
 - .13 Where electrically or electronically operated hardware is specified on the Architects' schedules or details of the final approved schedule and templates provided by the hardware supplier, hardware enclosures and/or junction boxes, where indicated on the templates, shall be provided and interconnected with CSA Approved 12.7mm diameter conduit and connectors.
 - .14 Prepare doors to receive security door contacts – refer to electrical drawings for locations. Door contacts to be installed at 100 mm from the latch side door edge.
 - .15 Doors and Frames shall be prepared for, but not limited to preparations for heavy weight oversized Butt Hinges, Continuous Hinges, Cylindrical Locksets, Concealed Vertical Rod and Mortise Lock Case Exit Devices, Surface Door Closer and concealed Overhead Stops.
- .3. Glazing:
- .1 Where 6mm thick glazing materials are specified on the Architects schedules or details, doors shall be provided with 20 gauge steel glazing trim and snap-in glazing stops.
 - .2 Where other than 6mm glazing is specified on the Architect's schedules or details, doors shall receive 20 gauge steel trim and screw fixed glazing stops. Screws shall be #6 x 32mm oval head scruox (self-drilling) type at 300mm on center maximum.
 - .3 Glazing trim and stops shall be accurately fitted, butted at corners, with removable glazing stops located on the 'push' side of the door.
- .4 Louver Preparations:
- .1 Where specified on the Architect's schedules or details, non-labeled doors shall be prepared on accordance with the louver manufacturer's details.
 - .2 Where specified on the Architect's schedules or details, fire labeled doors shall be prepared for UL listed sight-proof fusible link louvers in accordance with the louver manufacturer's details.
 - .3 Louvers shall be supplied and installed by others.

- .5 Finishing:
 - .1 Remove weld slag and splatter from exposed surfaces.
 - .2 All tool marks, abrasions and surface blemishes shall be filled and sanded to present smooth uniform surfaces.
 - .3 On exposed surfaces where zinc coating has been removed during fabrication, doors shall receive a factory applied touch-up primer.
 - .4 Primer shall be fully cured prior to shipment.

2.2 Panels

1. Panels shall be fabricated from the same materials, construction and finished in the same manner as doors as specified in Section 2.1.

2.3 Frame Product

1. Materials

- .1 Steel:

Frame product shall be fabricated from tension leveled steel to ASTM A924-M97, galvanized to ASTM A653-M97, Commercial Steel (CS), Type B, coating designated ZF75, known commercially as paintable Galvanneal.
- .2 Primer:

Rust inhibitive touch up only.
- .3 Miscellaneous:
 - .1 Door Silencers:

GJ-64, Single Stud rubber/neoprene type
 - .2 Thermal Breaks:

Rigid polyvinylchloride (PVC) extrusion
 - .3 Fiberglass:

Loose batt type, density: 24kg/m³ (minimum), conforming to ASTM C665

2. Construction

- .1 General:
 - .1 All steel frame product shall be as manufactured by Fleming of the types, sizes and profiles indicated on the Architects' schedules or details.
 - .2 Exterior frames shall be thermally broken, Fleming *Therma-Frame* Series, fabricated from 16 gauge steel.
 - .3 Exterior frame product shall be supplied profile welded (PW)
 - .4 Interior and exterior sections of thermally broken frames shall be separated by a continuous PVC thermal break.
 - .1 Thermally broken sections shall not be assembled by means of screws, grommets or other fasteners and welds shall not cause thermal transfers between interior and exterior surfaces of the frame sections.

-
- .2 Closed sections (mullions and center rails) of thermally broken frames shall be factory insulated with 24kg/m³ loose batt type fiberglass material.
 - .5 Insulation of open sections (jamb, heads and sills) on exterior frame product shall be provided and installed by the contractor responsible for installation.
 - .6 Interior frames shall be Fleming F-Series, fabricated from 16 gauge steel.
 - .7 Interior frame product shall be supplied profile welded (PW)
 - .8 Knocked-down and knocked-down drywall frames shall not be acceptable.
 - .9 Jamb, heads, mullions, sills and center rails shall be straight and uniform throughout their lengths.
 - .10 Frame product shall be square, free of defects, wraps or buckles.
 - .11 Corner joints shall be profile welded (PW) (continuously welded on the inside of the profiles' faces, rabbets, returns and soffit intersections with exposed faces filled and ground to a smooth, uniform, seamless surface)"
 - .12 Joints at mullions, transom bars, sills or center rails shall be coped accurately, butted and tightly fitted, with faces securely welded, matching corner joint faces.
 - .13 All steel mullions will be fabricated from the same materials as specified for the steel frames. Steel mullions will be fabricated as a fully assembled three piece unit consisting of a front, back and full height one piece attachment clip as per Fleming F Series. The attachment clip will completely fill the stop area of the mullion on both sides and span the void between each side forming a grid channel like structure. Mullions used as hinge mullions or strike mullions between doors will be filled with grout by the general contractor either prior to or following installation of the frame. The head of the frame shall have an opening sufficient for the grout to be poured in to the mullion.
 - .14 Mullions shall be fabricated with continuous 20 gauge galvanized steel internal reinforcing clips.
 - .15 Frame product shall be fabricated with integral door stops having a minimum height of 16mm.
 - .16 Glazing stops shall be formed 20 gauge steel, 16mm height channel, accurately fitted, butted at corners and fastened to frame sections with #6 x 32mm oval head scrulox (self-drilling) type screws at 300mm on center maximum.
 - .17 Where required due to site access, as indicated on the Architects' schedules or details, when advised by the contractor responsible for co-ordination or installation, or when shipping limitations so dictate, frame product shall be fabricated in sections for splicing in the field.
 - .1 Field spliced jamb, heads and sills shall be provided with 16 gauge steel splice plates securely welded into one section, extending 100mm minimum each side of splice joint.
 - .2 Field splices at closed sections (mullions or center rails) shall be 16 gauge steel splice angles securely welded to the abutting member. Face of splice angle shall extend 100mm minimum into closed sections when assembled.
 - .3 Field splice joints shall be welded, filled and ground to present a smooth uniform surface by the contractor responsible for installation after assembly.

-
- .18 Each door opening shall be provided with two (2) temporary steel jamb spreaders welded to the base of the jambs or mullions to maintain proper alignment during shipping and handling. Spreaders shall be removed by the contractor responsible for installation prior to anchoring of frame to floor.
 - .19 Each door opening shall be prepared for GJ-64 or equivalent, single stud door silencers, three (3) for single door openings, two (2) for double door openings. Silencers shall be shipped loose for installation by the contractor after finish painting.
 - .20 Unless ineligible due to design, size, hardware or glazing specified on the Architects' or Hardware Suppliers' schedules or details, fire labeled frame product shall be provided for those openings required fire protection ratings as determined and scheduled by the Architect.
- .2 Hardware Preparations
- .1 Frame product shall be blanked, reinforced, drilled and tapped for fully templated mortised hardware only, in accordance with the final approved schedule and templated provided by the hardware supplier.
 - .2 Frame product shall be factory blanked and reinforced only for mortised hardware that is not fully templated.
 - .3 Frame product shall be reinforced only for surface mounted hardware.
 - .4 Drilling and tapping for surface mounted hardware or mortised hardware that is not fully templated shall be by the contractor responsible for installation on site, at the time of application.
 - .5 Frames shall be prepared for 127mm (5 inch) standard weight hinges (minimum).
 - .6 Hinge and pivot reinforcements shall be 10 gauge steel minimum reinforcing, high frequency type shall be provided.
 - .7 Hinge reinforcements for acoustic frames and frames in excess of 2450mm rabbet height shall be 10 gauge minimum with each cutout provided with 127mm (5 inch) heavy weight (4.6mm) high frequency type.
 - .8 Strike reinforcements shall be 16 gauge steel minimum.
 - .9 Reinforcements for surface mounted hardware, concealed closers and holders and flush bolts shall be 12 gauge steel minimum.
 - .10 Mortised cutouts shall be protected with 22 gauge steel minimum guard boxes.
 - .11 Where electrically or electronically operated hardware is specified on the Architects schedules or details or the final approved schedule and templates provided by the hardware supplier, hardware enclosures and/or junction boxes, where indicated on templates, shall be provided and inter-connected with CSA Approved 12.7mm diameter conduit and connectors.
 - .12 Prepare frames to receive security door contacts – refer to electrical drawings for locations. Door contacts to be installed at 100 mm from the latch side door edge.
- .3 Anchorage:
- .1 Frame product shall be provided with anchorage appropriate to floor, wall and frame construction.
 - .2 Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb, except as indicated below.

- .3 Frame product installed in unit masonry partitions shall be provided with 4.0mm diameter steel wire anchors, 18 gauge steel adjustable stirrup and strap or “T” type anchors as conditions dictate.
 - .4 Where frame product is installed prior to construction of the adjacent wall, each jamb shall be provided with 16 gauge steel floor anchors. Each anchor shall be provided with two (2) holes for mounting to the floor and shall be securely welded to the inside of the jamb.
 - .5 Floor anchors for thermally broken exterior frames shall be designed so as not to permit thermal transfers from exterior to interior surfaces of the frame sections.
 - .6 Frame product installed in drywall partitions shall be provided with 20 gauge steel snap-in or “Z” type stud type anchor.
 - .7 Jamb of frames in previously placed concrete, masonry or structural steel shall be punched and dimpled to accept machine bolt anchors, 6.4mm diameter, located not more than 150mm from the top and bottom of each jamb. Anchor preparations and guides shall also be located immediately above or below the intermediate hinge reinforcements and directly opposite on the strike jamb. Each preparation shall be provided with 16 gauge anchor bolt guides.
 - .8 Anchor bolts and expansion shell anchors for the above preparations shall be provided by the contractor responsible for installation.
 - .9 After sufficient tightening of the anchor bolts, the heads shall be welded do as to provide a non-removable application. Welded bolt head and dimple shall be filled and ground to present a smooth uniform surface by the contractor responsible for installation, prior to finish painting.
 - .10 Where indicated on the Architects’ schedules or details, channel extensions shall be provided from the top of the frame assembly to the underside of the structure above. Extensions shall be fabricated from 12 gauge steel formed channel, mounting angles welded to inside of frame head and adjusting brackets. Formed channels, adjusting brackets and fasteners shall be shipped loose. Channels shall be mechanically connected to mounting angles and adjusting brackets with supplied fasteners, on site, by contractor responsible for installation.
- .4 Finishing:
- .1 Remove weld slag and spatter from exposed surfaces.
 - .2 All tool marks, abrasions and surface blemishes shall be filled and sanded to present smooth and uniform surfaces.
 - .3 On exposed surfaces where zinc has been removed during fabrication, frame product shall receive a factory applied touch-up primer.
 - .4 Primer shall be fully cured prior to shipment.

2.4 Sizes and Tolerances

1. All sizes and tolerances shall be in accordance with the Canadian Steel Door Manufacturers Association “Recommended Dimensional Standards for Commercial Steel Doors and Frames” as follows:
 - .1 Widths of door openings shall be measured from inside of frame jamb rabbet with a tolerance of +1.6mm, -0.8mm.

- .2 Heights of door openings shall be measured from the finished floor (exclusive of floor coverings) to the head rabbet of the frame with a tolerance of $\pm 1.2\text{mm}$.
- .3 Unless builders' hardware dictates otherwise, doors shall be sized so as to fit the above openings and allow a 3mm clearance at jambs and head. A clearance of 19mm between the bottom of the door and the finished floor (exclusive of floor coverings) shall be provided. Tolerances on door sizes shall be $\pm 1.2\text{mm}$.
- .4 Manufacturing tolerances on formed frame profiles shall be $\pm 0.8\text{mm}$ for faces, door stop heights and jamb depths. Tolerances for throat openings and door rabbet shall be $\pm 1.6\text{mm}$ and $\pm 0.4\text{mm}$ respectively. Hardware cutout dimensions shall be as per template dimensions, +0.4mm, -0.

2.5 Hardware Locations

1. Hardware preparations in frame product shall be as noted below and locations on doors shall be adjusted for clearances specified in 2.4.
2. Top of upper hinge preparation for 114.3mm hinges shall be located 180mm down from head, transom mullion or panel as appropriate. The top of the bottom hinge preparation for 114.3mm hinges shall be located 310mm from finished floor as defined in 2.4.3. Intermediate hinge preparations shall be spaced equally between top and bottom cutouts. For dutch door frames, top and bottom hinge locations shall be as above, with the tops of intermediate hinges located at 930mm and 1403mm from finished floor.
3. Strike preparations for unit, integral, cylindrical and mortise locks and roller latches shall be centered 1033mm from finished floor. Strikes for deadlocks shall be centered at 1200mm from finished floor. Strikes for panic or fire exit hardware shall be located as per device manufacturer's templates.
4. Push and/or pulls on doors shall be centered 10701mm from finished floor.
5. Preparations not noted above shall be as per hardware manufacturer's templates.
6. Hardware preparation tolerances shall comply with the ANSI A115 series standards.

PART 3 - EXECUTION

3.1 Site and Protection of Materials

1. The contractor responsible for installation shall remove wraps or covers from door and frame product upon delivery at building site.
2. All materials shall be thoroughly inspected upon receipt and all discrepancies, deficiencies and/or damages shall be immediately reported in writing to the supplier. All damage shall be noted on the carriers' Bill of Landing.
3. Contractor responsible for installation shall ensure all materials are properly stored on planks or dunnage in a dry location. Product shall be stored in a vertical position,

spaced with blocking to permit air circulation between them. Materials shall be covered to protect them from damage from any cause.

4. Contractor shall notify the supplier in writing of any errors or deficiencies in the product itself before initiating any corrective work.

3.2 Installation

1. Install doors and frames in accordance with the Door and Hardware Institute "Installation guide for doors and hardware".
2. Set frame product plumb, square, aligned, without twist at correct elevation.
3. Frame Product Installation Tolerances:
 - .1 Plumbness tolerance, measured through a line from the intersecting corner of vertical members and the head to the floor, shall be $\pm 1.6\text{mm}$.
 - .2 Squareness tolerance, measured through a line 90° from one jamb at the upper corner of the product, to the opposite jamb, shall be $\pm 1.6\text{mm}$.
 - .3 Alignment tolerance, measured on jambs, through a horizontal line parallel to the plane of the wall, shall be $\pm 1.6\text{mm}$.
 - .4 Twist tolerance, measured at face corners of jambs, on parallel lines perpendicular to the plane of the wall, shall be $\pm 1.6\text{mm}$.
4. Fire labeled product shall be installed in accordance with NFPA-80.
5. Secure anchorages and connections to adjacent construction.
6. Brace frame product rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install wood spreaders at mid points of frame rabbet height and at floor level to maintain frame widths. Provide vertical support at center of head for openings exceeding 1250mm in width. Remove wood spreaders after product has been built-in.
7. Frame product in unit masonry shall be fully grouted in place.
8. Install doors maintaining clearances outlined in Section 2.4.
9. Install louvers and vents.
10. Adjust operable parts for correct clearances and function.
11. Steel surfaces shall be kept free of grout, tar or other bonding materials or sealers.
12. Any grout or other bonding material shall be cleaned from products immediately following installation.
13. Exposed field welds shall be finished to present a smooth uniform surface and shall be touched-up with a rust inhibitive primer.

14. Exposed surfaces that have been scratched or otherwise marred during shipment, installation or handling shall be touched-up with a rust inhibitive primer.
15. Finish paint in accordance with Section 09900.
16. Install glazing materials and door silencers.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Final cleaning:	Section 01710	
2. Sealants:	:	Section 07900
3. Glazing:	Section 08800	
4. Air Vapour Barrier Membrane:	Section 07112	

1.2 Design Requirements

1. This specification section is based on following aluminum glazing types:
 - .1 **Fixed window** - typical unit:
 - .1 E.g. Alumicor - RainBlade 2900 Series TrueLine, 146mm System Depth – **Double Glazed Units**.
 - .2 Typical for punched openings fixed windows.
 - .3 Acceptable – Old Castle
 - .2 **Horizontal Slider Operators**: - 100mm wide main frame depth, thermally broken frame and sash, **double glazed**, side slider thermal break. 25mm insulating glass unit glazing. Maximum allowable air leakage of 0.06 (m3/hr) m-1 @75 Pa and 23.30C (crack length = 3.20). CSA/CAN-A440 Ratings-A3,B7, C5. AAMA Rating – HC-55
 - .3 **Curtain wall**:
 - .1 Alumicor ThermaWall 2600 Series min. 160mm deep. **Double Glazed Unit**
 - .2 Old Castle Curtain Wall Systems
2. Typical window venting: horizontal sliders.
3. Design all framing and glazing to withstand design loads as per the Ontario Building Code and regulations of authorities having jurisdiction.
4. Work of this Section must be designed by a Professional Engineer licensed to design structures in the Province of Ontario.
5. Design and locate all sealants, gaskets, air/vapour seals, thermal barriers and separations, drainage slots and holes, as shown or specified or as required to obtain design requirements. Ensure all components and assemblies exterior to air barrier drain to building exterior.
6. Provide aluminum closer angles and trims to suit.
7. Curtain Wall:

- .1 Design curtain wall framing to provide free and noiseless movement of all components due to structural erection or dead loads, without buckling of any component and/or transmitting of stress to any other member.
 - .2 Spandrel panels: Glazed panel finish (SP) – Glazed Panel finish: to be dark gray glass on inner surface. Colour: to consultant's selection.
 - .3 Design curtain wall glazing system and framing to prevent thermal shock and pressure fracture damage to glass.
 - .4 Design pressure plates and glass retainers to place uniform pressure on glass, to prevent any distortion of glass.
 - .5 Heavy duty institutional application aluminum door package, thermally broken with insulated sealed units at exterior locations. e.g. Kawneer 350 Medium, or Alumicor Canadiana 400b or equal by other approved aluminum window manufacturers.
 - .6 Doors to be thermally broken and to have insulated sealed units at exterior location only.
8. Aluminum Exterior Doors - Aluminum Doors and Frames:
- .1 This specification is based upon Alumicor Limited doors – Canadiana Series 600B
 - .2 Doors to be thermally broken and to have insulated sealed units at exterior location only.
 - .3 Acceptable Equal Alternates: Kawneer and Oldcastle

1.3 Shop Drawings

1. Submit shop drawings in accordance with Section 01340 and to be prepared and stamped by a Professional Engineer licensed to design structures in the Province of Ontario.
2. Clearly indicate materials and large scale details for head, jamb and sill, profiles of components, elevations of unit, fully dimensioned layouts positioning brackets and anchorage details, glazing details, and location of isolation coating, description of related components and exposed finishes and fasteners.

1.4 Certificates

1. Submit manufacturer's certificate, certifying compliance with specification requirements, for:
 - .1 windows.
 - .2 finishes.
 - .3 insect screens.
 - .4 infiltration/exfiltration rates.
 - .5 thermal transfer resistance of frames.
 - .6 locking hardware.

1.5 Performance

1. In addition to all requirements of these specifications, the design of glazing shall take into consideration the characteristics of the mullions and effects of the connection and sealants at the frame junctions. Provide thermal breaks between exterior and interior components and sufficient metal on interior side of glass.

2. Fenestration shall meet CAN/CSA – A440 windows:
 - .1 Air Leakage: A3
 - .2 Water Leakage: B7
 - .3 Wind Load Resistance: C5
 - .4 Condensation Resistance: fixed frame: 53 minimum
glass: 53 minimum
 - .5 Window shall also meet the requirements for blocked operation, ease of operation, sash strength, stiffness and resistance to forced entry.
3. Submit manufacturer's certificate, certifying compliance with the above-noted requirements.

1.6 Quality Assurance

1. All design, fabrication and installation of this work to be carried out by qualified workers and trades experienced in the application and erection of the products, systems and assemblies specified.
2. Make provisions to drain to the exterior face any water entering in at joints and any condensation occurring within curtain wall construction while maintaining air seal between interior and exterior. Drain holes shall adequately drain all water.
3. At design conditions, no water penetration to interior side of assembly shall occur.
4. Curtain wall systems shall be designed, fabricated, and installed under design conditions to be watertight in combination with movements occurring due to wind loads imposed on the system.
5. Formed aluminum components shall be sheet of alloy and temper suitable for their purpose and finish.

1.7 Warranty

1. Provide written warranty stating that aluminum windows are guaranteed against leakage, defects and malfunction under normal usage for a period of ten (10) years from the date of completion.

1.8 Maintenance Material

1. Provide data for maintenance and cleaning in accordance with general conditions.

PART 2 – PRODUCTS

2.1 Manufacturers

1. Equivalent Manufacturers for the work of this sections:
 - .1 Kawneer Company Canada
 - .2 Alumicor Limited
 - .3 Oldcastle Glass
 - .4 Alwind

2.2 Materials

1. Extrusions shall be 6063 T54 alloy and temper.
2. Formed aluminum components shall be sheet of alloy and temper suitable for their purpose and finish.
3. Fasteners shall be 300 series stainless steel or 400 series stainless steel cadmium plated and of sufficient size and quantity to perform their intended function.
4. Weathering and glazing gaskets shall be extruded, black, closed cell or dense elastomer of durometer appropriate to the function.
5. Glazing tapes shall be macro-polyisobutylene, highly adhesive and elastic with built in shim.
6. Exterior Sills: extruded aluminum, minimum 3 mm thick, complete with joint covers, jamb drip deflectors, chairs, anchors, anchoring devices. All lower level sills to have exterior corners rounded to 6mm radius.
7. Sealants: in accordance with Section 07900, paragraph 2.1.3. Color to match window frame.
8. Foam Sealants: Urethane expanding foam sealant.
9. Bedding Compound: to CGSB 19-GP-14M.
10. Isolation Coating: alkali resistant bituminous paint.

2.3 Finish

1. Exposed aluminum sections shall be given an anodic oxide treatment in accordance with Aluminum Association specification AA-M12C22A31. Kawneer #17 Clear.

2.4 Fabrication

1. Fabricate framing from extrusions of size and shape shown on shop drawings. Interior and exterior extruded aluminum framing sections shall be integrated with a glass reinforced nylon thermal break to form a rigid composite assembly without the use of fasteners or other thermal bridging elements.
2. Composite frame assembly shall have a minimum of 1100 lbf/4 in. (4815N/ 100 mm) resistance to shear between the aluminum and the thermal break materials.
3. Dry shrinkage of the thermal break shall not exceed 0.10% of the framing member length.
4. Fixed framing shall be designed for screw spline corner construction. 518 ISOPORT frameless vent operating sash extrusions shall be tubular with mitred, clip, adhesive, stake joint construction.
5. All framing joints shall be accurately machined, assembled, and sealed to provide neat weathertight connections. Coupling mullions shall be designed to provide a functional split

to permit modular construction and allow for thermal expansion. Glass stops shall be lock-in screwless type.

6. All glazing pockets shall be vented, pressure equalized and drained to the exterior.
7. Elastomeric air seal gasket shall be installed around the full perimeter of glass and sealed at corners with silicone sealant. Air seal gasket must provide adhesion with silicone sealant.
8. Insulated Panels (ISP) – Anodized or Prefinished aluminum cover sheet, mineral wools semi-rigid insulation in galvanized steel back pan to be held in place with stick pins clips and continuously sealed to frame. Panel finish: Duranar XL, three coat, coil-coated finish containing Kynar 500 polyvinylidene fluoride resin. Colour: to consultant's selection. Interior panel finish is anodized aluminum unless noted otherwise.
9. Glazed panel finish (SP) – Glazed Panel finish: to be dark gray glass on inner surface. Colour: to consultant's selection. Refer to building elevations for location.

2.5 Isolation Coating

1. Isolate aluminum from following components, by means of isolation coating:
 - .1 Dissimilar metals except stainless steel, zinc, or white bronze or small area.
 - .2 Concrete, mortar and masonry.
 - .3 Wood.

2.6 Glazing

1. Prepare windows to receive 25 mm thick double glazed insulating glass specified under Section 08800.

PART 3 - EXECUTION

3.1 Preparation

1. Protect adjacent surfaces from damage resulting from work under this specification.

3.2 Installation

1. Install the windows in accordance with the manufacturer's instructions. Install the windows plumb, level and true relative to building structure. Do not exceed 3mm in 3050 mm (1/8" in 10'0") variation from plumb and level. Foam insulate between the frame members and the window opening using a single component polyurethane foam, insulating sealant.

3.3 Sill Installation

1. Install prefabricated metal sills with uniform wash to exterior, level in length, straight in alignment with plumb upstands and faces. Sills to be one continuous aluminum piece.

3.4 Caulking

1. Seal joints between frame members and other non-operating components with sealant to provide weathertight seal at outside.
2. Seal joints between windows and windowsills with sealant. Bed sill expansion joint cover plates and drip reflectors in bedding compound. Caulk between sill upstand and window-frame. Caulk butt joints in continuous sills.

3.5 Clean Up

1. Clean glass at the factory. Final cleaning of glass to remove job site soiling shall be the responsibility of the owner. Leave all surfaces reasonably clean, free from sealants, caulking or other foreign material. Remove all surplus materials and debris resulting from the work of this Trade.

3.6 Protection and Cleaning

1. Aluminum shall be isolated from concrete, mortar, plaster or dissimilar metals with bituminous paint or epoxy solution. Framing shall be protected from other building materials during and after installation until acceptance.

End of Section



2090 Shirley Drive Kitchener Ontario N2B 0A3

Phone: (519) 578.1000 Toll Free: (800) 265.8959 Fax: (519) 578.3262

Schedule of Finish Hardware

ARCHITECT/DESIGNER: GRGURIC ARCHITECTS INC.
28 KING STREET EAST - UNIT B
STONE CREEK ON L8G 1J8
PHONE - 905-664-8735
FAX - 905-664-8737

CONTRACTOR:

PHONE -
FAX -

PROJECT: WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET
KITCHENER ON
7648

PROJECT CONSULTANT: VISHAL KACHCHHI

PREPARED: February 09, 2026

REVISED: February 09, 2026

SUBMITTAL



Scan to check
out our website

DOOR INDEX

Mark	Heading #	Mark	Heading #	Mark	Heading #
C100A	C100A	155B	155B		
1S1A	1S1A	2S1A	2S1A		
1S1B	1S1B	2S2A	2S2A		
1S2A	1S2A	201A	201A		
1S2B	1S2B	202A	202A		
141A	141A	203A	203A		
142A	142A	203B	203B		
142B	142B	204A	204A		
143A	143A	205A	205A		
144A	144A	206A	206A		
145A	145A	207A	207A		
145B	145B	210A	210A		
146A	146A	210B	210B		
147A	147A				
148A	148A				
149A	149A				
150A	150A				
153A	153A				
154A	154A				
154B	154B				
155A	155A				



KNELLS DOOR & HARDWARE

WCDSB - ST. ALOYSIUS CES ADDITION

2090 SHIRLEY DRIVE

KITCHENER

Tel: 519-578-1000

ON

N2B 0A3

Fax: 519-578-3262

Control No.7648

7648

Hardware Finishes

Finish	Description
26D	SATIN CHROMIUM PLATED
32D	SATIN STAINLESS STEEL, 300 SERIES
626	SATIN CHROMIUM
630	SATIN STAINLESS STEEL
689	POWDER COAT, ALUMINUM
ALUMINUM	ALUMINUM
C.A.	CLEAR ANODIZED
C26D	SATIN CHROMIUM
C32D	STAINLESS STEEL, SATIN
CL	CLEAR
PC	PRIME COAT
US26D/US32D	STAINLESS STEEL - SATIN
US32D	STAINLESS STEEL - SATIN



KNELLS DOOR & HARDWARE

WCDSB - ST. ALOYSIUS CES ADDITION

2090 SHIRLEY DRIVE

KITCHENER

Tel: 519-578-1000

ON

N2B 0A3

Fax: 519-578-3262

Control No.7648

7648

February 09, 2026

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 141A

1 SGL DOOR 141A EXST. CORRIDOR E100 TO EX. CLASSROOM 141

90° LH

900 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

Heading # 142A

1 SGL DOOR 142A EXTERIOR FROM EX. CLASSROOM

90° LHR

955 x 2186 x 44 ALD Door/ ALF Frame

NON-RTD Door/NON-RTD Frame

1	CONTINUOUS HINGE	SL27 CL LL X 2159MM X SDTF	CL	SEL
1	RIM EXIT DEVICE	CD-98EO X 299 X 4-0	US32D	VON
1	MORTISE CYLINDER	10T0500-26-DBS-Z34 1-1/4 MORTISE CYLINDER WITH SCHLAGE CAM	626	G&A
1	OVERHEAD STOP, CONCEALED	104S	US32D	GLY
1	CLOSER	4040XP.RWPA.689.SRT	689	LCN
1	DOOR SWEEP	W-38S X 950MMW	C.A.	KNC
1	THRESHOLD	CT-75 X 950MM	ALUMINUM	KNC

INTEGRAL WEATHERSTRIPPING BY DOOR SUPPLIER.

Heading # 142B

1 SGL DOOR 142B EXST. CORRIDOR E100 FROM EXST. CLASSROOM 142

90° LHR

950 x 2150 x 45 EXST Door/ EXST Frame

NON-RTD Door/NON-RTD Frame

1	RIM EXIT DEVICE	98L-BE-F X 996L-BE(#06) X 299F X 4-0	US26D/US32 D	VON
1	CLOSER	4040XP.RWPA.689.SRT	689	LCN

EXISTING DOOR TO BE EQUIPPED WITH NEW EXIT HARDWARE AND CLOSER.

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 143A

1 SGL DOOR 143A CORRIDOR C100 TO CLASSROOM

90° LH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

Heading # 144A

1 SGL DOOR 144A CORRIDOR C100 TO CLASSROOM

90° RH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

Heading # 145A

1 SGL DOOR 145A CORRIDOR C100 TO CLASSROOM

90° RH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

HARDWARE SCHEDULE - CODE # 7648

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 145B

1 SGL DOOR 145B CLASSROOM 144 TO CLASSROOM 145

90° RH

950 x 2150 x 44 WD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INSTITUTION LOCK	195DW X G3 X KD	26D	MRK
2	CYLINDER	20J200V1-26-DQM (AB,F)	626	G&A
1	OVERHEAD STOP	904S	US32D	GLY
1	CLOSER	4040XP.RWPA.689.SRT	689	LCN
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	SMOKE SEAL	W-66 X 17-2		KNC
1	AUTO DOOR BOTTOM, SURFACE	CT-50 X 950MMOA	C.A.	KNC
1	DROP PLATE	4040XP-18G.689	689	LCN

Heading # 146A

1 SGL DOOR 146A CORRIDOR C100 TO CLASSROOM

90° LH

950 x 2150 x 44 HMD Door/ HMF Frame

45 MIN Door/45 MIN Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

Heading # 147A

1 SGL DOOR 147A CORRIDOR C100 TO CLASSROOM

90° RH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 148A

1 SGL DOOR 148A CORRIDOR C100 TO WORK ROOM

90° RH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

Heading # 149A

1 SGL DOOR 149A CORRIDOR C100 FROM MACHINE ROOM

90° RHR

950 x 2150 x 44 HMD Door/ HMF Frame

45 MIN Door/45 MIN Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	STOREROOM LOCK	175F X E7 X G3	26D	MRK
1	CYLINDER	20J200V1-26-DQM (AB,F)	626	G&A
1	OVERHEAD STOP	904S	US32D	GLY
1	CLOSER	4040XP.RWPA.689.SRT	689	LCN
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	DROP PLATE	4040XP-18G.689	689	LCN

Heading # 150A

1 SGL DOOR 150A CORRIDOR C100 FROM I.T. CLOSET

90° RHR

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	STOREROOM LOCK	175F X E7 X G3	26D	MRK
1	CYLINDER	20J200V1-26-DQM (AB,F)	626	G&A
1	OVERHEAD STOP	904S	US32D	GLY
1	CLOSER	4040XP.RWPA.689.SRT	689	LCN
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	DROP PLATE	4040XP-18G.689	689	LCN

HARDWARE SCHEDULE - CODE # 7648

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 153A

1 SGL DOOR 153A CORRIDOR C100 TO STAFF WASHROOM

90° RH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM
1	STOREROOM LOCK	175F X E7 X G3
1	CYLINDER	20J200V1-26-DQM (AB,F)
1	INDICATOR DEADBOLT	D271 X 30-253 X 10-094
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM
1	WALL STOP	GSH 240

26D	MCK
26D	MRK
626	G&A
626	FAL
C32D	GAL
C26D	GAL

INSTALL DEADLOCK AT 6" C/L ABOVE 161.

Heading # 154A

1 SGL DOOR 154A CORRIDOR C100 TO FILES

90° RH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM
1	ENTRY LOCK	175AB X E7 X G3
1	CYLINDER	20J200V1-26-DQM (AB,F)
1	OVERHEAD STOP	904S
1	CLOSER	4040XP.RWPA.689.SRT
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM

26D	MCK
26D	MRK
626	G&A
US32D	GLY
689	LCN
C32D	GAL

Heading # 154B

1 SGL DOOR 154B FILES FROM MECHANICAL ROOM

90° RHR

950 x 2150 x 44 HMD Door/ HMF Frame

45 MIN Door/45 MIN Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM
1	STOREROOM LOCK	175F X E7 X G3
1	CYLINDER	20J200V1-26-DQM (AB,F)
1	OVERHEAD STOP	904S
1	CLOSER	4040XP.RWPA.689.SRT
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM
1	DROP PLATE	4040XP-18G.689

26D	MCK
26D	MRK
626	G&A
US32D	GLY
689	LCN
C32D	GAL
689	LCN

HARDWARE SCHEDULE - CODE # 7648

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 155A

1 SGL DOOR 155A EXTERIOR FROM EX. CLASSROOM

90° LHR

955 x 2186 x 44 ALD Door/ ALF Frame

NON-RTD Door/NON-RTD Frame

1	CONTINUOUS HINGE	SL27 CL LL X 2159MM X SDTF	CL	SEL
1	RIM EXIT DEVICE	CD-98EO X 299 X 4-0	US32D	VON
1	MORTISE CYLINDER	10T0500-26-DBS-Z34 1-1/4 MORTISE CYLINDER WITH SCHLAGE CAM	626	G&A
1	OVERHEAD STOP, CONCEALED	104S	US32D	GLY
1	CLOSER	4040XP.RWPA.689.SRT	689	LCN
1	DOOR SWEEP	W-38S X 950MMW	C.A.	KNC
1	THRESHOLD	CT-75 X 950MM	ALUMINUM	KNC

INTEGRAL WEATHERSTRIPPING BY DOOR SUPPLIER.

Heading # 155B

1 SGL DOOR 155B EXST. CORRIDOR E100 FROM EXST. CLASSROOM 155

90° LHR

950 x 2150 x 45 EXST Door/ EXST Frame

NON-RTD Door/NON-RTD Frame

1	RIM EXIT DEVICE	98L-BE-F X 996L-BE(#06) X 299F X 4-0	US26D/US32 D	VON
1	CLOSER	4040XP.RWPA.689.SRT	689	LCN

EXISTING DOOR TO BE EQUIPPED WITH NEW EXIT HARDWARE AND CLOSER.

HARDWARE SCHEDULE - CODE # 7648

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 1S1A

1 PR DOORS 1S1A EXTERIOR FROM STAIR 1S1

90° RHR,LHR

950/950 x 2150 x 44 ALD Door/ ALF Frame

NON-RTD Door/NON-RTD Frame

2	CONTINUOUS HINGE	SL27 CL LL X 2159MM X SDTF	CL	SEL
1	MULLION	EL980 X 86	PC	SAR
2	RIM EXIT DEVICE	CD-98EO X 299 X 4-0	US32D	VON
1	CYLINDER	10J0400-26-DQM (RIM CYLINDER FOR ALL NON-SARGENT EXITS)	626	G&A
2	MORTISE CYLINDER	10T0500-26-DBS-Z34 1-1/4 MORTISE CYLINDER WITH SCHLAGE CAM	626	G&A
1	CYLINDER	10J0200-26-DQM-Z20 (1-1/8 CYLINDER W/ SARGENT T CAM)	626	G&A
1	ELECTRIC STRIKE	9600-12/24D-630	630	ES-CD
2	PULL	GSH 1180-1 X #2	C32D	GAL
2	OVERHEAD STOP, CONCEALED	104S	US32D	GLY
1	CLOSER	4040XP.RWPA.689.SRT INSTALL INTO ADO HEADER	689	LCN
1	AUTO OPERATOR	MICOM KIT 25318 DOUBLE HEADER WIRED ADO (SW800 DOUB HEAD ADO, 1 ACTIVE & 2 BUTTONS-INSTL)	AL	G&A
2	DOOR SWEEP	W-38S X 950MMW	C.A.	KNC
1	THRESHOLD	CT-75 X 1900MM	ALUMINUM	KNC
1	DROP PLATE	4040XP-18G.689	689	LCN

120VAC TO HEADER, ALL CONDUIT AND LOW VOLTAGE WIRING BY ELECTRICAL.
INTEGRAL WEATHERSTRIPPING BY DOOR SUPPLIER.
CARD READER BY SECURITY.

Heading # 1S1B

1 PR DOORS 1S1B STAIR 1S1 FROM CORRIDOR C100

90° RHR,LHR

950/950 x 2150 x 44 HMD Door/ HMF Frame

45 MIN Door/45 MIN Frame

6	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
2	SVR EXIT DEVICE	9827L-BE-F X 996L-BE(#06) X 499F X 4-0 X 2150MMH X LBR	US26D/US32 D	VON
2	CLOSER	4040XP.RWPA.689.SRT	689	LCN
2	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
2	WALL STOP	GSH 240	C26D	GAL
2	ELECTROMAGNETIC HOLDER	EM 508-24120	689	DKB

120VAC TO MAG HOLDER BY ELECTRICAL.

HARDWARE SCHEDULE - CODE # 7648

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 1S2A

1 PR DOORS 1S2A EXTERIOR FROM STAIR 1S2

90° RHR,LHR

950/950 x 2150 x 44 ALD Door/ ALF Frame

NON-RTD Door/NON-RTD Frame

2	CONTINUOUS HINGE	SL27 CL LL X 2159MM X SDTF	CL	SEL
1	MULLION	EL980 X 86	PC	SAR
2	RIM EXIT DEVICE	CD-98EO X 299 X 4-0	US32D	VON
1	CYLINDER	10J0200-26-DQM-Z20 (1-1/8 CYLINDER W/ SARGENT T CAM)		G&A
2	MORTISE CYLINDER	10T0500-26-DBS-Z34 1-1/4 MORTISE CYLINDER WITH SCHLAGE CAM	626	G&A
1	CYLINDER	10J0400-26-DQM (RIM CYLINDER FOR ALL NON-SARGENT EXITS)	626	G&A
1	ELECTRIC STRIKE	9600-12/24D-630	630	ES-CD
2	PULL	GSH 1180-1 X #2	C32D	GAL
2	OVERHEAD STOP, CONCEALED	104S	US32D	GLY
1	CLOSER	4040XP.RWPA.689.SRT INSTALL INTO ADO HEADER	689	LCN
1	AUTO OPERATOR	MICOM KIT 25318 DOUBLE HEADER WIRED ADO (SW800 DOUB HEAD ADO, 1 ACTIVE & 2 BUTTONS-INSTL)	AL	G&A
2	DOOR SWEEP	W-38S X 950MMW	C.A.	KNC
1	THRESHOLD	CT-75 X 1900MM	ALUMINUM	KNC
1	DROP PLATE	4040XP-18G.689	689	LCN

120VAC TO HEADER, ALL CONDUIT AND LOW VOLTAGE WIRING BY ELECTRICAL.
INTEGRAL WEATHERSTRIPPING BY DOOR SUPPLIER.
CARD READER BY SECURITY.

Heading # 1S2B

1 PR DOORS 1S2B STAIR 1S2 FROM CORRIDOR C100

90° RHR,LHR

950/950 x 2150 x 44 HMD Door/ HMF Frame

45 MIN Door/45 MIN Frame

6	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
2	RIM EXIT DEVICE	98L-BE-F X 996L-BE(#06) X 299F X 4-0	US26D/US32 D	VON
1	ELECTRIC STRIKE	9500-12/24D-630	630	ES-CD
1	CLOSER	4040XP.RWPA.689.SRT INSTALL INTO ADO HEADER	689	LCN
1	AUTO OPERATOR	MICOM KIT 25318 DOUBLE HEADER WIRED ADO (SW800 DOUB HEAD ADO, 1 ACTIVE & 2 BUTTONS-INSTL)	AL	G&A
2	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
2	ELECTROMAGNETIC HOLDER	EM 508-24120	689	DKB

120VAC TO HEADER, ALL CONDUIT AND LOW VOLTAGE WIRING BY ELECTRICAL.
FIXED MULLION BY HM.

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 201A

1 SGL DOOR 201A CORRIDOR C200 TO CLASSROOM

90° LH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

Heading # 202A

1 SGL DOOR 202A CORRIDOR C200 TO CLASSROOM

90° RH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

Heading # 203A

1 SGL DOOR 203A CORRIDOR C200 TO CLASSROOM

90° RH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

HARDWARE SCHEDULE - CODE # 7648

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 203B

1 SGL DOOR 203B CORRIDOR C200 TO CLASSROOM

90° RH

950 x 2150 x 44 WD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INSTITUTION LOCK	195DW X G3 X KD	26D	MRK
2	CYLINDER	20J200V1-26-DQM (AB,F)	626	G&A
1	OVERHEAD STOP	904S	US32D	GLY
1	CLOSER	4040XP.RWPA.689.SRT	689	LCN
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	SMOKE SEAL	W-66 X 17-2		KNC
1	AUTO DOOR BOTTOM, SURFACE	CT-50 X 950MMOA	C.A.	KNC
1	DROP PLATE	4040XP-18G.689	689	LCN

Heading # 204A

1 SGL DOOR 204A CORRIDOR C200 TO CLASSROOM

90° LH

950 x 2150 x 44 HMD Door/ HMF Frame

45 MIN Door/45 MIN Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

Heading # 205A

1 SGL DOOR 205A CORRIDOR C200 TO CLASSROOM

90° RH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 206A

1 SGL DOOR 206A CORRIDOR C200 TO WORK ROOM

90° LH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	INTRUDER LOCK	195DB X G3	26D	MRK
2	CYLINDER	20J200V0-26-DQM (DB,S)	626	G&A
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

Heading # 207A

1 SGL DOOR 207A CORRIDOR C200 TO STAFF WASHROOM

90° LH

950 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	STOREROOM LOCK	175F X E7 X G3	26D	MRK
1	CYLINDER	20J200V1-26-DQM (AB,F)	626	G&A
1	INDICATOR DEADBOLT	D271 X 30-253 X 10-094	626	FAL
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
1	WALL STOP	GSH 240	C26D	GAL

INSTALL DEADLOCK AT 6" C/L ABOVE 161.

Heading # 210A

1 SGL DOOR 210A CORRIDOR C200 FROM CUSTODIAN ROOM

90° LHR

1100 x 2150 x 44 HMD Door/ HMF Frame

45 MIN Door/45 MIN Frame

3	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
1	STOREROOM LOCK	175F X E7 X G3	26D	MRK
1	CYLINDER	20J200V1-26-DQM (AB,F)	626	G&A
1	OVERHEAD STOP	904S	US32D	GLY
1	CLOSER	4040XP.RWPA.689.SRT	689	LCN
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 1062MM	C32D	GAL
1	DROP PLATE	4040XP-18G.689	689	LCN

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # 210B

1 SGL DOOR 210B EXTERIOR/ROOF FROM CUSTODIAN ROOM

90° LHR

1100 x 2150 x 44 HMD Door/ HMF Frame

NON-RTD Door/NON-RTD Frame

3	HINGE, 5, HVY WT	MPB99 127MM X 114MM NRP	32D	MCK
1	INSTITUTION LOCK	195DW X G3 X KD	26D	MRK
2	CYLINDER	20J200V1-26-DQM (AB,F)	626	G&A
1	OVERHEAD STOP	904S	US32D	GLY
1	CLOSER	4040XP.RWPA.689.SRT	689	LCN
1	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 1062MM	C32D	GAL
1	WEATHER STRIPPING	W-52S X 1100MM X 2150MM	C.A.	KNC
1	DOOR SWEEP	W-38S X 1100MMW	C.A.	KNC
1	THRESHOLD	CT-75 X 1100MM	ALUMINUM	KNC
1	DROP PLATE	4040XP-18G.689	689	LCN

Heading # 2S1A

1 PR DOORS 2S1A STAIR 2S1 FROM CORRIDOR C200

90° RHR,LHR

950/950 x 2150 x 44 HMD Door/ HMF Frame

45 MIN Door/45 MIN Frame

6	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
2	RIM EXIT DEVICE	98L-BE-F X 996L-BE(#06) X 299F X 4-0	US26D/US32 D	VON
2	CLOSER	4040XP.RWPA.689.SRT	689	LCN
2	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
2	WALL STOP	GSH 240	C26D	GAL
2	ELECTROMAGNETIC HOLDER	EM 508-24120	689	DKB

120VAC TO MAGHOLDER BY ELECTRICAL.
FIXED MULLION BY HM.

Heading # 2S2A

1 PR DOORS 2S2A STAIR 2S2 FROM CORRIDOR C200

90° RHR,LHR

950/950 x 2150 x 44 HMD Door/ HMF Frame

45 MIN Door/45 MIN Frame

6	HINGE, 4 1/2, HVY WT	MPB68 114MM X 114MM	26D	MCK
2	RIM EXIT DEVICE	98L-BE-F X 996L-BE(#06) X 299F X 4-0	US26D/US32 D	VON
2	CLOSER	4040XP.RWPA.689.SRT	689	LCN
2	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 912MM	C32D	GAL
2	WALL STOP	GSH 240	C26D	GAL
2	ELECTROMAGNETIC HOLDER	EM 508-24120	689	DKB

120VAC TO MAGHOLDER BY ELECTRICAL.
FIXED MULLION BY HM.

WCDSB - ST. ALOYSIUS CES ADDITION
504 CONNAUGHT STREET

Heading # C100A

1 PR DOORS C100A EXISTING CORRIDOR E100 FROM CORRIDOR C100

90° RHR,LHR

1100/1100 x 2150 x 44 HMD Door/ HMF Frame

90 MIN Door/90 MIN Frame

6	HINGE, 5, HVY WT	MPB68 127MM X 114MM	26D	MCK
2	SVR EXIT DEVICE	9827L-BE-F X 996L-BE(#06) X 499F X 4-0 X 2150MMH X LBR	US26D/US32 D	VON
2	CLOSER, REGULAR ARM	4040XP.RWPA.689.SRT	689	LCN
2	KICK PLATE	GSH 80A X 2-SIDED TAPE X 203MM X 1062MM	C32D	GAL
2	WALL STOP	GSH 240	C26D	GAL
2	ELECTROMAGNETIC HOLDER	EM 508-24120	689	DKB
1	WEATHER STRIPPING	W-66 X 25		KNC

120VAC TO MAGHOLDER BY ELECTRICAL.

Heading # LOOSE1

1 LOOSE1

o

x x Door/ Frame

10	CYLINDER	20J009S4-26-DQM	26D	MED
10	CABINET LOCK - 1-T1	MED-OL-700LCM-26D		G&A

CABINET LOCK TO BE INSTALLED ON TEACHERS CABINET WITH CLOSET ROD.
COORDINATE WITH MILLWORK.

PART 1 - GENERAL

1.1 Related Work

1. Final Cleaning:	Section 01710
2. Commercial Steel Doors and Frames:	Section 08100
3. Aluminum Windows:	Section 08520

1.2 Submittals

1. Submit a 300 x 300 sample of all glass products in accordance with Section 01340.

1.3 Warranty

1. Contractor hereby warrants glass against defects and failure, including leakage, under normal conditions of use, in accordance with Division 1, but for five (5) years total

PART 2 - PRODUCTS

2.1 Material

1. **Exterior Tempered Safety Glass:** All exterior Vision Glass to exterior doors, windows and screens to be double sealed insulating units conforming to CAN/CGSB-12.8. Exterior lite 6 mm tempered grey float glass, 12 mm air filled space, inner lites 6 mm clear tempered float glass conforming to CAN/CGSB-12.3. All units to receive Low Emissivity coating on inner pane (3rd surface).
2. **Interior Tempered Safety Glass:** Two (2) x 6 mm tempered clear float glass complete with etched tempered glass designation visible.
3. **Polished Plate or Float Glass:** To CAN/CGSB-12.3 clear.
4. **Fire Rated Glass:** To CAN 4 S-104 and CAN 4 S-106 to meet ANSI Z97.1. Shall be 3/16" (5mm) thick FireLite-Premium supplied by TechniGlas or approved equal.
5. **Low E Glass:** to CAN/CGSB-12.4; tempered clear, sputtered coating; eg. AGC Glass Comfort TI-PB; PPG Sungate 100
6. **Setting blocks:** neoprene, 80 durometer hardness, 102 mm x 6 mm width to suit glass.
7. **Glazing tape:** preformed butyl with continuous spacer, 10-15 durometer, hardness, paper release, black color, 3 x 10 mm.
8. **Gasket:** black neoprene "U" cavity type with lock strip.

PART 3 - EXECUTION

3.1 Installation

1. Triple Glazed Sealed Units

- .1 Install glass as per aluminum window manufacturer's instruction to provide complete rain screen and air/ water barrier.

2. Other Glass

- .1 Clean and dry surfaces.
- .2 Apply glazing tape to fixed stops. Place setting blocks at 1/3 points.
- .3 Set glass on setting blocks against tape.
- .4 Apply glazing tape to glass.
- .5 Install stops.
- .6 Install glass in doors and screens with neoprene gasket.
- .7 Clean glass prior to building occupancy in accordance with Section 01710.

End of Section

PART 1 - GENERAL

1.1 General Finish Notes

1. The Material and Colour Schedule will be issued by the Consultant after tender. It shall be read in conjunction with the Drawings, Specifications, Room Schedule and Door Schedule. Colour and material references named will be based on one manufacturer, as carried by the Contractor or, in the case that no specific manufacturer is carried, based on the Consultant's choice.
2. Approved alternative manufacturers will be acceptable only as indicated in the specifications. However, approved alternate products submitted must match the products named in the Specification to the Consultant's selection. Alternate products other than those named in the specifications will not be allowed unless previously approved by the Consultant.
3. Consult Architect prior to painting any surface not included in the formulae as listed.
4. Final colour for exterior painted surfaces and prominent interior areas shall be approved on the job site by the Architect.
5. Paint samples: Contractor to submit paint samples for all areas required to "Match Adjacent Finish".
6. All similar paint formulations are to be identical when dry. Variations in tone, texture or sheen shall not be accepted.
7. Submit two 300 mm x 300 mm paint samples of each colour required for approval by the Architect.
8. Exact locations of accent paint called for in the Material and Colour Schedule, to be issued after Contract award, not specifically identified on the drawings are to be verified on site with the Architect.

1.2 Exterior Finish Notes

1. All exposed metal (doors, frames, lintels, stairs, handrails, mechanical equipment, etc.) to be painted except for prefinished metal louvers, stainless steel, and aluminum. Mechanical equipment is to be painted whether delivered to the site prepainted or not (exhaust fans, goosenecks, exhaust stacks, supports, HVAC units, HRU units, etc.). Colours to match adjacent material-generally either to match brick or tan to match flashing or siding material. Do not paint exposed white PVC pipe covers on interior. Architect will advise on jobsite which other items mentioned above, if any, do not require painting.
2. All unfinished metal work provided by landscaping is to be painted by Section 09900.

1.3 Interior Finish Notes:

1. All heating units, recessed convectors, grilles, pipes, access panels, hangers and miscellaneous exposed metal work (except stainless steel or anodized aluminum) to be painted to match the surfaces on which they occur unless noted otherwise on the colour schedule, prefinished in suitable colour or directed by the Architect. If prefinished equipment is damaged, it shall be re-painted. Painting to be by formulations specified in Section 09900.
2. All interior fitments, casework, millwork, etc. to be melamine unless otherwise noted. Refer to Sections for specific requirements regarding materials, construction, finishes and hardware. Note that drawer and cupboard interiors are to be considered as exposed surfaces and will therefore be finished.
3. Do not paint over nameplates, identification tags, etc.
4. Make good all existing surfaces and finishes that are damaged during construction.

1.4 Abbreviations Legend

1. Refer to Room Finish Schedule for abbreviations Legend.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Gypsum Board: Section 09250

1.2 Reference Standards

1. Do work to CSA A82.31, except where specified otherwise.

PART 2 - PRODUCTS

2.1 Materials

1. Non-load bearing channel stud framing: to ASTM C645, roll formed from 0.59 mm thickness electro-galvanized steel sheet for screw attachment of gypsum lath and metal lath. Knock out service holes at 150 mm o.c.
2. Floor and ceiling tracks: to ASTM C645-76 in width to suit stud sizes, 30 mm legs for floor track, 50 mm for ceiling track.
3. Metal channel stiffener: 38 mm size, 2 mm thick cold rolled galvanized steel.
4. Furring channels (channels, hangers, tie wire, insert, anchor): CSA A82.30 (R-1971).
5. Metal Accessories: CSA A82.30-1965 (R-1971).

PART 3 - EXECUTION

3.1 Stud Partitions

1. Align partition tracks at floor and underside of structure above and secure at 600 mm o.c. maximum. All partitions to extend to underside of structure above.
2. Place studs vertically at 400 o.c. and not more than 50 mm from abutting walls and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs, as required, to provide rigid installation to manufacturer's instructions.
3. Erect metal studding to tolerance 1:1000.
4. Attach studs to bottom track using screws.
5. Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs, ensure web openings are aligned.
6. Install steel frames and anchor frames securely to studs using minimum of three (3) anchors per jamb for jambs up to 2100 mm high and a minimum of four (4) anchors per jambs for jambs over 2100 mm high.

7. Provide two (2) studs at each side of openings wider than stud centre specified.
8. Install, cut to length, piece of runner horizontally over door frames and at top and bottom of rough opening in glazed partitions.
9. Provide 38 mm x 89 mm vertical and horizontal wood studs secured between metal studs for attachments of bathroom fixtures, accessories, cabinet work, and other fixtures, including grab bars, towel rails, attached to steel stud partitions.
10. Install steel stud or furring channel between studs for attaching electrical and other boxes.
11. Extend all partitions to underside of deck above for sound and fire separation. Fill deck flutes with rockwool.
12. Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.

3.2 Ceiling Furring

1. Install runners level to tolerance of 3 mm over 3.5 m. Provide runners at interruptions of continuity and change in direction.
2. Frame with furring channels, perimeter of openings to accommodate access panels, light fixtures, diffusers, grilles, etc.
3. Furr for bulkheads within or at termination or ceilings.
4. Install furring channels at 400 mm o.c. maximum.

3.3 Wall Furring

1. Install steel furring, as indicated.
2. Frame opening and around built-in equipment on four (4) sides with channels.
3. Box-in beads, columns, pipes, and around exposed services.

3.4 Fire-rated Assemblies

1. If required, install Metal Stud System and Furring in accordance with appropriate ULC Design and with supplement to the National Building Code of Canada 2015.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Masonry:	Section 04200
2. Metal Stud System:	Section 09111
3. Supply of access doors for mechanical and electrical devices	Divisions 15 and 16

1.2 Reference Standards

1. Do work to CSA A82.31-1977, except where specified otherwise.

PART 2 - PRODUCTS

2.1 Gypsum Board

1. Plain: to CSA A82.27-M1977 standard, 16 mm or 19 mm thick or as indicated, tapered edges.
2. Plain: to CSA A82.27-M1977, Fire-rated Type X, 16 mm thick or as indicated, tapered edges.
3. Plain: to CSA A82.27-M1977 standard, 13 mm water resistant, tapered edges.
(W.R.G.B. in Finish Schedule)
4. Plain: to CSA A82.27-M1977, walls 5/8" dens-shield or as indicated, tapered edges.
5. Two Hour Shaft Wall to CSA A82.27-M1977 – ULC W452 System B/W506, W507 UL Design 415 Sysem B or U438

2.2 Fastenings and Adhesives

1. Screws: to CSA A82.31-1977.
2. Adhesive: to CGSB 71 GP 25M.
3. Laminating Compound: to CSA A82.31-1077.
4. Concrete Anchors: Phillips Red Head TW-614 or equivalent. Do not use powder activated fasteners for ceiling support.
5. Tie Wire: #16 ga. galvanized soft annealed steel wire.

2.3 Accessories

1. Casing Beads and Corner Beads: 0.5 mm base thickness commercial sheet steel with G90 zinc finish to ASTM A 525-78 A.

2. Joint compound and tape: Compound to CSA A82.31-1977, asbestos-free. Perforated 50 mm gypsum board joint tape.
3. Caulking: Acoustical sealant.

2.4 Insulation Blanket

1. 38 mm thick mineral wool batts ULC labelled, where indicated on drawings.

PART 3 - EXECUTION

3.1 Gypsum Board Application

1. Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work are approved.
2. Install metal studs plumb and true to sizes and locations indicated on drawings.
3. Apply single and double layers gypsum board to metal furring or framing, using screw fasteners and laminating adhesive. Maximum spacing of screw 300 mm oc.
4. Apply gypsum board to concrete block surfaces, where indicated, using laminating adhesive.
5. Apply type 16mm X gypsum board where indicated, in accordance with U.L.C. requirements and with supplement to the National Building Code of Canada to obtain the required fire protection, fire rating and fire separation.

3.2 Insulation and Blanket Application

1. Where indicated on drawings, staple blanket to wallboard in accordance with ULC design requirements. Blanket shall be continuous and tightly fitted between studs and at perimeter.

3.3 Accessories

1. Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces, where practical. Make joints tight, accurately aligned and rigidly secure. Mitre and fit corners accurately, free from rough edges.
2. Install casing beads around perimeter of suspended ceilings.
3. Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated.

3.4 Access Doors

1. Install access doors to electrical and mechanical fixtures specified in respective Sections.
2. Rigidly secure frames to furring or framing systems.

3.5 Taping and Filling and Sound Seal

1. Seal with acoustical sealant at ceilings, floors, wall intersections and all penetrations such as electrical outlets.
2. Above partitions fill flutes of steel deck with rock wool and cover with non-sagging sealant on at least one side of the partition.
3. Finish face panel joint and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
4. Finish corner beads, control joints and trim as required with two (2) coats of joint compound and one (1) coat of taping compound, feathered out onto panel faces.
5. Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after painting is completed.
6. Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
7. Completed installation to be smooth, level or plumb, free from waves and other defects and ready for painting.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Sealants	Section 07900
2. Gypsum Board	Section 09250

1.2 Reference Standards

1. Do tile work to Installation Manual 200-1979, "Ceramic Tile," produced by Terrazzo Tile and Marble Association of Canada (TTMAC).

1.3 Environmental Conditions

1. Main minimum 13 deg. C air temperature at tile installation area for 24 hr. prior to, during and 48 hr. after installation. Do not proceed without the correct tiles or if substrate conditions are not suitable.

1.4 Maintenance Material

1. Provide one full box of each type and color of tile required for project for maintenance use. Store where directed. Clearly identify each box.
2. Maintenance material to be of same production area as installed material.

1.5 Extended Warranty:

1. Submit a warranty for entire wall tile installation, covering materials and labour and the repair or replacement of defective work for a period of three (3) years total.

PART 2 - PRODUCTS

2.1 Thin-Set Mortar

1. Mortarcrete Latex Mortar conforming to ANS1A118.4-1973, manufactured by L & M Ceramo Inc.

2.2 Wall Tile at Drinking Fountain

1. **Ceramic Wall Tile (CWT):** to CAN2-75, 1-M77, Type 5, Class MR-4, Maple Leaf's Colour & Dimension Collection, 100 x 100 x 6 mm size, cushion edges, glazed surface. Colours as selected by consultant up to a maximum of three (3) colours; Olympia Tile.
 - .1 Acceptable Materials:
Centura – Beltile Rainbow Series; size 4x16 glossy full colours.
Daltile

2. Tile walls – see drawings for extent. Patterns and accent stripes to be selected by Architect.
2. Tile colors to be selected by Architect from Standard Color List. Total of three (3) colours. Accent stripes colors to be selected separately by Architect from "Accent Color" List. Total of two (2) colours.
3. Tile Edge -

2.3 Grout

1. Epoxy Grout: "Latapoxy SP-100" Stainless, chemical resistant epoxy grout by Laticrete International. Colour from manufacturer's full range.
2. Edging and trim by Schluter – Jolly for edges and outside corners and top of tile edge.

PART 3 - EXECUTION

3.1 Workmanship

1. Apply tile to clean and sound surfaces.
2. Fit tile around corners, fitments, fixtures, drains and other built-in objects to maintain a joint uniform appearance. Cut edges smooth, even and free from chipping. Edges resulting from splitting, not acceptable.
3. Maximum surface tolerance 1:800 for walls, floors.
4. Make joints between tile uniform, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.
5. Lay out tiles so perimeter tiles are minimum 1/2 size.
6. Sound tiles after setting and replace hollow-sounding units to obtain full bond.
7. Make internal angles square, external angles rounded.
8. Use round edged tiles at termination of wall tile panels, except where panel butts projecting surface or differing plane.
9. Install soap dishes into block recess. Fit tiles around soap dishes.
10. Allow minimum 24 h after installation of tiles, before grouting.
11. Clean installed tile surfaces after installation and grouting cured.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Sealants: caulking

Section 07900

1.2 Reference Standards

1. Do tile work to Installation Manual 200-1979, "Ceramic Tile," produced by Terrazzo Tile and Marble Association of Canada (TTMAC), except where specified otherwise.

1.3 Maintenance Material

1. Provide maintenance data for tile work for incorporation into Maintenance Manual specified in Section 01720.
2. Provide 12 additional tiles of each type and color of tile required for project for maintenance use. Store where directed. Clearly identify each box.
3. Maintenance material to be of same production area as installed material.

1.4 Environmental Requirements

1. Air temperature and structural base temperature at tile installation area must be above 13 degrees C for 24 hours before, during and 24 hours after installation.

1.5 Extended Warranty:

1. Submit a warranty for entire flooring tile installation, covering materials and labour and the repair or replacement of defective work for three (3) years total.

PART 2 - PRODUCTS

2.1 Tiles

1. Designation PT: 300 mm x 600 mm porcelain tile to CAN 2-75-1M77.
 - .1 **Acceptable material:** Dotti Series, distributed by Centura: Size 300 mm x 300 mm, plus trim and 300 mm x 100 mm bullnosed base, matte finish. Allow for up to 3 colours from manufacturer's full line.

NOTE: At all adjacent floor finishes ensure the adjacent surface is feather up to be flush with the porcelain tile finish – **NO transition strips will be accepted.**
 - .2 Acceptable Alternates: Regal Series – Olympia Tile
Daltille

2.2 Accessories

1. Control Joints – Schluter – Dilex –KSN for floors and walls with Tiles.

2. Expansion Joints for Wall and Ceiling:

Wall – Spring Thunder – Wall expansion Joint IL1 – 100mm wide
Floor – Spring Thunder – Flush heavy duty expansion joint cover FHL – 100mm wide
Equal Alternates acceptable.

3. Tactile Walking Surface Indicator (TWSI): 4mm thick polymer tiles with 5mm high truncated domes. Tile size: 300mm x 300mm. Size as shown on drawings.

Location: at top of stairs and at stair landing in the up or down location.

Basis of Design: EON tile by Kinesik Engineered Products.

4. Nosing Visual Strip: Schluter 2 1/8" x 5/16"x8'-2 1/2" TREP-SE/-S/-B slip resistant stair nosing.

Location: Exit stairwells.

2.3 Setting Materials

1. Cement Mortar: Mixture of 1 part Portland cement, 4 parts dry sand and 1/10 hydraulic lime. Materials shall conform to the following:
2. Portland Cement: To CAN3-A, Type 10.
3. Hydrated Lime: To ASTM C-206 or 207, Type 5.
4. Sand: To CSA A82.56, passing 1.6 mm sieve.
5. Water: Potable, containing no contaminants which cause efflorescence.
6. Thin Set Mortar: field mixed, blended sand-Portland cement-latex mortar, "Kerapoxy" by Mapei, distributed by Midgley and West, Hamilton Ontario.
 - .1 Acceptable Alternates: "Laticrete 4237 distributed by Ceratec Inc., or Flextile 52 thin set.
 - .2 Latex Additive: "Cemtex" by Master Builders, Laticrete 2022" distributed by Ceratec Inc.

2.4 Grout

1. Sanded, Portland cement based with Plastijoints acrylic additive, Kerncolour / Floor by Mapei or similar by Laticrete. Colour as selected by Architect.

PART 3 - EXECUTION

3.1 Workmanship

1. Apply tile to clean and sound surfaces.
2. Fit tile units around corners, fitments, fixtures, drains and other built-in objects to maintain uniform joint appearance. Make cut edges smooth, even and free from chipping. Edges resulting from splitting not acceptable.

3. Maximum surface tolerance: 1:800.
4. Make joints between tiles uniform and approximately 3 mm wide, (maximum 4 mm) plumb, straight, true, even and with adjacent units flush. Align patterns.
5. Lay out units so perimeter tile are minimum 1/2 size.
6. Install floor tiles as per pattern. Pattern will be supplied by architect at a later date.
7. Sound tiles after setting and replace hollow sounding units to obtain full bond.
8. Make internal angles square, external angles chamfered at 45° with narrow tile strip.
9. Construct base, as indicated on drawings, with rounded top edge.
10. Use bullnose edged tiles at termination of wall tiles, except where tiles abut projecting surface or differing plane.
11. Seal grouted joints with sealer.
12. Clean installed tile surfaces after installation cured.
13. Keep building expansion joints free of mortar or grout.
14. Tiles must be flush with adjacent dissimilar finishes. Add leveler at lower floor finishes to porcelain tile at all door openings, feather back as required to eliminate visible elevation difference around doorways. Typical at all locations.
15. Install steel floor termination strip at all door openings where porcelain tile meets VCT.

3.2 Setting System

1. Install porcelain floor tiles in accordance with TTMAC applicable thinset detail.

End of Section

PART 1 - GENERAL

1.1 Reference Standards

1. Fabrication: to ASTM 365-78 and CAN/GSB-92.1-M77.
2. Installation: to ASTM C636-76, except where specified otherwise.

1.2 Design Criteria

1. Maximum deflection 1/360 of span to ASTM 365-78 deflection test.

1.3 Samples

1. Submit two each 300 x 300 mm samples of each individual tile and grid type in accordance with Section 01340.

1.4 Warranty

1. Submit an extended warranty covering materials and labour and the repair or replacement of defective work but for two (2) years total.

PART 2 - PRODUCTS

2.1 Materials

1. Ceiling Types:

Ceiling Type 1 (ACT-1): Panels: 610 mm x 1220 mm x 15mm, medium textured non directional fissured, square lay-in, Cortega #823 by Armstrong. Suspension system: 15/16" Prelude ML, white, by Armstrong.

Equivalent ceiling types by CertainTeed, CGC and Celotex are acceptable.

2. **Hangers:** 2.6 mm galvanized soft annealed steel wire.
3. **Accessories:** splices, clips, retainers, etc., to complement suspension system components.

2.2 Installation

1. Co-ordinate suspension system with related components.
2. Install acoustic units parallel to building lines with edge unit not less than 50% of unit width.
3. Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.
4. Support suspension system main runners at 1200 oc maximum with hangers from structure. Assembly shall support super-imposed loads. Maximum permissible deflection, 1/360 of span.

-
5. Attach cross member to main runner to provide rigid assembly.
 6. Install suspension assembly to manufacturer's written instructions.
 7. Install flush edge moulding at junction of acoustic unit ceiling and other materials around entire length of joint. Secure to construction. Butt joints neatly, square and true in alignment.
 8. Set acoustic units in place.
 9. Set all ceiling levels by the use of transit or laser level.
 10. Provide for Owner one FULL (1) complete carton of each type of ceiling tile.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Cast-in-Place Concrete: concrete floors

1.2 Maintenance Data

1. Provide data for maintenance of resilient flooring for incorporation into Maintenance Manual.

1.3 Environmental Requirements

1. Maintain minimum 20 deg. C air temperature at flooring installation area for three (3) days before, during and for seven (7) days after installation.

PART 2 - PRODUCTS

2.1 Materials

1. **Vinyl composition tile (VCT):** to ASTM F 1066-1995 a, Type A design, asbestos free, 3 mm thick, 300 mm x 300 mm size Standard Excelon, Imperial Texture for field and Multicolour for accent and pattern by Armstrong. Allow for total of three (3) colours from full line. Allow 90% of area in Imperial texture and 10% in Multicolour.
Acceptable Alternate: Mannington Commercial: Designer Essentials Series.
Azrock Collection by johnsonite
2. **Resilient rubber base (RB):** top set coved, 3 mm thick, rubber, 100 mm high minimum 1200 mm long, including premoulded end stops and external corners. Acceptable materials: non-shrink Rubber Wall Base with toe as manufactured by Johnsonite. Colours: Three (3) from full Johnsonite "Coloright" colour line. Use straight base at carpet flooring.
3. **Stair Treads and Nosing:** thermostat vulcanized rubber; 6 mm thick tapering to 3 mm thick, full width and depth of stair tread in one piece; ribbed pattern; 50 mm wide inlaid strip on nosing for visually impaired design; 50 mm return down edge of tread with tapered thickness; eg. Tarkett/Johnsonite VIHD; colour as selected by Consultant.
4. **Tactile Walking Surface Indicator (TWSI):** 3mm thick polymer tiles with 5mm high truncated domes. Tile size: 300mm x 300mm. As indicated on Stair drawings.
Basis of Design: EON tile by Kinesik Engineered Products Acceptable equal:
6. **Base Accessories:** Pre-moulded end stops and external corners, of same material, size, and colour as base.
7. **Transition Strips:** thermoset vulcanized rubber, smooth, purpose made to accommodate wheeled traffic and prevent tripping; tapered designs to suit nature of transition; colour as selected by Consultant.

8. **Primers and adhesives:** waterproof, recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade. Use Johnsonite 990 Solvent Free Environmentally Safe White Acrylic Cove Base Adhesive for rubber base.

PART 3 - EXECUTION

3.1 Inspection

1. Ensure concrete floors are dry, by using test methods recommended by tile manufacturer, and inspect for negative alkalinity, carbonization or dusting.
2. Commencement of work indicates acceptance of conditions by flooring installer.

3.2 Subfloor Treatment

1. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with subfloor filler.
2. Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured.
3. Ensure of smooth transition between any raised surfaces at door ways. Prepare subfloor with leveling compound to ensure smooth transition. Typical where VCT / LVT meets PT floors.

3.3 Tile

1. Apply adhesive uniformly using recommended notched trowel in accordance with Flooring Manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
2. Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles - minimum half tile width or as indicated by drawings and Finish Schedule.
4. Cut tile and fit neatly around fixed or excessively heavy objects.
5. Install flooring in pan type floor access covers and all clean out covers, where applicable. Maintain floor pattern.
6. Terminate flooring at center line of door in openings where adjacent floor finish or color is dissimilar.
7. Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.4 Base Application

1. Set base in adhesive tightly against wall and floor surfaces. Use lengths as long as practicable and not less than minimum 500 mm long.

2. Install straight and level to variation of 1:1000.
3. Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
4. Miter internal corners. Use premoulded corner pieces at all external corners and ensure full adhesion through to ends of corner pieces. See detail for termination at door frames.
5. Leave in the building one (1) complete carton of each of two (2) colours of floor tile and twelve (12) tiles of each of the remaining colours. Colours of extra tile to be specified by Architect.

3.5 Initial Maintenance after Installation

1. Broom sweep or vacuum thoroughly.
2. Do not wet mop, wash, scrub, or strip the floor. These procedures will be done by the Owner.

3.6 Protection of Work

1. Following broom sweeping, protect new floors with 0.15 mm thick Polyethylene cover and lay planking in all necessary traffic areas to minimize damage by other trades. Maintain until just before final inspection.

3.7 Preparation for Inspection

1. Only if so notified by Architect, and in the presence of the Owner, scrub the floor using a neutral detergent and a floor machine of 170-250 rpm capability equipped with a scrub brush or a scrubbing pad (3M blue or equal).
2. Lightly rinse and allow to dry. Note: Do not flood the floor with rinse water, scrubbing, or stripping solutions. Final re-washing, if required, and waxing will be done by owner.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. Masonry	Section 04200
2. Shop painting Miscellaneous Metals	Section 05510
3. Commercial Steel Door and Frames	Section 08100
4. Door Schedule Notes and Room Finishes Schedule	refer to drawings
5. Finish and Colour Notes	Section 09010

1.2 Reference Standard

1. Ontario Painting Contractors Association (OPCA) Architectural Specification Manual - referenced as OPCA Manual, latest Edition. Paint formulations and methods referred to herein refer to this Manual. If contractor is unfamiliar with this reference standard, contact the OPCA.

1.3 Environmental Requirements

1. Do not apply paint finish in areas where dust is being generated.
2. Conform to requirements of OPCA Manual.
3. Comply with the requirements of Section 01570 - Health and Environmental Specifications.

1.4 Finishes and Colours

1. Review the requirements outlined in Section 09010 - Finish and Colour Notes. A separate colour schedule will be issued after contract award.

1.5 Warranty

1. Provide a two (2) year warranty on completion stating that the work has been performed with respect to the standards and requirements incorporated in the OPCA specification manual latest edition.

PART 2 - PRODUCTS

2.1 Materials

1. Acceptable products: Per Chapter 5 OPCA Manual and as listed.
2. Paint materials for each paint system to be products of a single manufacturer.
3. Use low-VOC and low-odour paints only.

PART 3 - EXECUTION

3.1 Preparation of Surfaces

1. Prepare surfaces to receive paint per Chapter 3 OPCA Manual.

3.2 Application

1. Sand and dust between each coat to remove defects visible from distance up to 1.5 m.
2. Finish closets and alcoves as specified for adjoining rooms.
3. Apply each coat at the proper consistency. Each coat of finish should be fully dry and hard before applying the next coat, unless the manufacturer's instructions state otherwise.

3.3 Mechanical and Electrical Equipment

1. Refer also to Finish Notes in Section 09010.
2. Paint exposed conduits, pipes, hangers and other mechanical and electrical equipment occurring in finished areas as well as inside cupboards and cabinet work. Colour and texture to match adjacent surfaces, except as noted otherwise. Coordinate with mechanical trades applying banding and labeling after pipes have been painted. Do not paint white PVC covers on exposed mechanical water, drain and other lines.
3. Paint gas piping standard yellow where visible on roof or in service spaces. Do not paint gas meter or gas equipment in wall niche yellow—colour to later selection by Architect.
4. Paint surfaces inside of ductwork and elsewhere behind grilles where visible using primer and one coat of matte black paint.
5. Paint both sides and edges of plywood backboards for equipment before installation.
6. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.4 Paint Systems

1. System references listed are based on Chapters 4A and 4B of OPCA Manual and are OPCA Premium Grade, unless noted otherwise.

3.5 Interior Finishes

1. Wood, where applicable:
 - .1 Doors, miscellaneous trim: INT. 1-A, Alkyd Semi-Gloss Finish, Premium Grade
 - .2 Casework and miscellaneous wood items:
 - .1 Exterior surfaces: INT. 1-A, Alkyd Semi-Gloss Finish, Premium Grade

- .2 Interior surfaces: INT. 1-A, Alkyd Semi-Gloss Finish, Premium Grade
- .3 Wood Benches and Upper Shelves: INT. 2-F, Stained Alkyd Satin Finish, Premium Grade.
- .4 Gym Storage Shelves: INT. 3-A, Stain Finish, Custom Grade
- 2. Gypsum board: INT.4-B, Latex Eggshell Finish, Premium Grade.
- 3. Concrete Block: INT. 8-A, Latex Semi-Gloss Finish, Premium Grade;
- 4. Concrete Block: Alkyd Gloss Finish, Premium Grade
- 5. Concrete Floors, refer to Section 03346 - Concrete Floor Hardeners and Sealers for liquid sealer.
- 6. Exposed Cast in Place Concrete ceilings: INT. 8-A, Latex Flat Finish, Premium Grade
- 7. Exposed Precast Concrete ceilings: INT. 8-A, Latex Flat Finish, Custom Grade
- 8. Structural Steel and Miscellaneous Metal:
 - .1 Primed: INT. 12-A, Alkyd Semi-Gloss Finish, Premium Grade
 - .2 Galvanized: INT. 13-A, Alkyd Semi-Gloss Finish, Premium Grade
- 9. Galvanized metal: INT. 13-A, Alkyd Semi-Gloss Finish, Premium Grade
- 10. Galvanized steel deck: INT 13E, Alkyd dry fall.

3.6 Exterior Finishes

- 1. Wood: EXT. 1-A-Gloss, Premium Grade
- 2. Pavement markings: EXT. 7-A, Zone Marking Alkyd Finish, Premium Grade.
- 3. Miscellaneous metal:
 - .1 Primed: EXT. 11-A-Gloss, Premium Grade
 - .2 Galvanized: EXT. 12-A-Gloss, Premium Grade
- 4. Galvanized metal: EXT. 12-A-Gloss, Premium Grade.
- 5. Steel - high heat: EXT. 15-A

3.7 Preparation of Previously Painted Surfaces

- 1. Remove screws, bolts, nails, etc. from all surfaces to be painted
- 2. Remove all peeling and scaling paint by scraping and sanding.
- 3. Remove loose and broken pieces. Fill all holes, cracks and crevices with appropriate patching compound and match surrounding texture. Touch-up with appropriate primer.

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4. Remove all dirt, grease, oil, wax and other contaminants by scrubbing with a detergent solution such as trisodium phosphate. Rinse with clean water.
 3. All metal surfaces must be washed with mineral sprits. Change solvent and rags frequently. Remove all rust by sanding. Prime with rust inhibitive paint.
 4. Dull all glossy surfaces by sanding.
 7. Wash with solvent surfaces that have been subject to writing with marking pens, crayons, or lipsticks. Prime to stop bleeding.
 8. For joints within or adjacent to exterior areas to be painted or cleaned, remove old cracked and loose caulking and replace with a high-quality caulking compound.

End of Section

PART 1 - GENERAL

1.1 Shop Drawings

1. Submit shop drawings in accordance with Section 01340.

PART 2 - PRODUCTS

2.1 Fixtures

1. **Tackboard (TB)** - As manufactured by Architectural School Products, Mississauga; natural coloured cork tackboard:
 - .1 Single layer cork sheet 6 mm thick; natural color, on 6 mm particle board to Can 3.188.1-M78, Grade R.
 - .2 Extruded aluminum trim No. 205, 1.5 mm wall thickness, mitred, clear anodized finish
 - .3 Concealed steel fastenings (1 coat CGSB 1-GP-81e baked primer) to toggle bolts. Do not fasten to wall with adhesive.
 - .4 Size: as per drawings 1200 H x 3600 Long. Due to oversize dimension, construct with single centre seam in materials using No. 207 divider bar.
 - .5 Acceptable alternates: Martack Specialties Limited.
2. **White Board (WB)** - "Vit-Rite: Rite on, Wipe off" model as manufactured by Architectural School Products, Mississauga.
 - .1 Color: White. Flush trim No. 205, chalk tray No. 212, 89 mm deep, minimum,
 - .2 Provide all hardware and fasteners suitable for secure recessed mounting.
 - .3 Size, as per drawings.
 - .4 Acceptable alternates: Martack Specialties Limited.
 - .5 In addition to the white boards shown on the drawings supply and install where indicated on site by the consultant 6 additional units 1200 mm x 2400 mm.
3. **Window Coverings**
 - 1) Manufacturer - KW Blinds / 200Vic
 - 2) Model: SheerWeave – Style 4800, made from vinyl –coated polyester yarns.
 - 3) Fire Classification – CAN/ULC-S109-03 – NFPA 701 TM#2 Large Scale, ASTM E 84 Class 1
 - 4) Bacteria and Fungal Resistance and Microban antimicrobial additives
 - 5) Roll up shades with 10 year interior warranty.
 - 6) Size to suit window openings.
 - 7) Cordless operation required.
 - 8) Openness Factor- approx. 1%
 - 9) UV Blockage: approx. 99%
 - 10) Fabric Thickness: 0.036 in. or (0.91mm)
 - 11) Location: at all exterior windows except second floor stairwell W5.
 - 12) Colour: By architect from standard selection.

4 Coat Racks (CR):

- .1 Model STL 1001 Student Line as manufactured by ASI, Architectural School Products, Mississauga as selected by Consultant. Standard arrangement of 2 ABS hooks arranged on 2nd and 4th tubes with spacing to be 150mm on center.
- .2 Colours:
 - .1 Single Colour Frame: BAYCO ANODIZED
 - .2 ABS double hooks: BLACK
 - .3 Locations: as noted on drawings.

5. Bicycle Racks:

Heavy duty high quality steel; manufactured by Outdoor Equipment - galvanized steel finish, one year guaranteed against defects in workmanship and materials. Basis of design: Parco Style #4 Galvanized Model No. NJ115 to match with existing. Quantity: refer to Site Plan. Anchor into concrete slab as per manufacturer recommendations for anchoring.

6. Scooter Storage Racks

- 1. Aluminum with powder coated finish.
- 2. Size: holding up to 20 scooters accessible from both sides.
- 3. Ground anchor plates with 4 predrilled plates with 13mm diameter concrete anchors for each plate.
- 4. Quantity: 1 unit Location: near bike racks
- 5. Acceptable Manufacturer: Marchants Model SKU LO-SR20

PART 3 – EXECUTION

3.1 Installation

- 1. Install where indicated on drawings and as per manufacturer's instructions.

3.2 Demonstration and Training

- 1. Provide demonstration of operation to the Owner and his representatives.
- 2. Provide training for operation, maintenance and repairs.

End of Section

PART 1 - GENERAL

1.1 General Requirements

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

1.2 Related Work

1. Washroom Accessories: Section 10800

1.3 Submittals

1. Shop Drawings: Submit shop drawings in accordance with Section 01340, for Consultant's review before fabrication, indicating material, finish, dimensions, details of connections and fastenings, elevations, plans, sections, thicknesses, hardware and other pertinent information.
2. Samples: Submit samples of finish hardware and powder-coated sample in selected colour and finish in accordance with Section 01340, for approval of Consultant.

PART 2 - PRODUCTS

2.1 Material Description

1. **Metal Toilet Partitions (MTP)**: Standard series, by Hadrian Manufacturing
Acceptable alternatives: Bradley Corporation, Global Steel Products Corporation, Mitchell Div 10 Ltd.
Doors and partitions to extend 50mm from floor and 150mm from underside of ceiling.
 1. Heavy Duty SS latches
 2. Continuous SS hinges.
 3. Full length aluminum brackets thru bolted
 4. Anti-graffiti coating
 5. Colour by Architect – Standard series - allow for 2 colours.
- .1 **Urinal Divider Panels: 600mm wide x 1500mm high headrail braced**: 25 mm thick and 0.76 mm thick steel sheet faces with honeycomb core and internal reinforcing. Mounted 300mm from the finished floor.
- .2 **Hardware**: .67 institutional extra heavy duty, type 304 satin finish stainless steel, angle brackets, U-channels and spring-loaded, self-closing continuous hinge run full height of panel and door; for emergency access, door lift from outside. All fasteners to be pin-head Torx screws.

PART 3 – EXECUTION

3.1 Installation

1. Install compartments in accordance with reviewed shop drawings and in a neat, rigid manner free of defects.
2. Install units secure, accurately positioned, plumb, level, square and free from sag and distortion.
3. Perform drilling of steel, masonry and concrete necessary to install this work.
4. Ensure spaces between panels and pilasters, between panels and walls and between pilasters and walls are of uniform consistent width and sized to ensure it is not possible to see persons using the compartments.
5. Coordinate installation with the work of trades providing ceilings, wall and floor finishes, shower accessories and other adjacent components and construction.

3.2 Adjustment

1. Upon completion of the work or when directed, remove all traces of protective coating or paper.
2. Clean exposed surfaces and fittings.
3. Test hinges, locks and latches and where necessary, adjust and lubricate. Set hinges so that doors stand open maximum 30 degrees when compartment is not in use. Ensure that partitions are in working order.

End of Section

PART 1 - GENERAL

1.1 General Requirements

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

1.2 Related Work Specified Elsewhere

1. Electrical conduit and wiring to junction boxes and hand dryers: refer to Electrical

1.3 Referenced Standards

1. ASTM A167-87: Specification for Stainless and Heat Resisting Chromium -Nickel Steel Plate, Sheet and Strip
2. ASTM A525: Standard Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process (Metric)
3. CAN/CSA-G164-M92: Hot Dip Galvanizing of Irregularly Shaped Articles.

1.4 Shop Drawings

1. Submit shop drawings in accordance with Section 01340, for Consultant's review before fabrication. Shop drawings of units for use by the handicapped shall be distinctly marked and cross-referenced to the corresponding article in the specifications.

1.5 Quality Standard

1. This specification section is based generally on Bobrick equipment. Similar equipment and accessories by ASI Group Watrous Inc. and American Specialties Inc. are also acceptable.

PART 2 - PRODUCTS

2.1 Materials - Generally

1. Ferrous Steel: Sheet, cold-rolled furniture steel, double annealed, mill stretched and leveled, and fully pickled. Otherwise, steel shall be hot-rolled or cold-rolled of alloy to suit needs of fabrication, use, and appearance.
2. Stainless Steel: Type 304, conforming to ASTM A167-87, No. 4 finish.
3. Galvanized Steel: For sheet, Z275 zinc coating designation in accordance with ASTM Specification A525. For irregular sections, hot dip galvanized to comply with CSA G164.
4. Anchors and Fastenings: Where exposed, use stainless steel and otherwise to match metal anchored. Where non-exposed, use the same as that specified for exposed, or

use galvanized steel. Anchors and fastenings shall be of the type appropriate for the substrate to which accessory unit is secured.

2.2 Products

1. Mirrors

- .1 **(M1)** B-290 series by Bobrick, stainless steel frame, vandal resistant mounting, 6 mm glass mirror with 15 year guarantee against silver spoilage.
Size: 600 x 910 mm. Quantity: refer to drawings

2. Handicapped Grab Bars (GB): Series B-5806 by Bobrick

- .1 GB-1: B-5806 x 600 mm long bar behind water closet. Installed as per drawing.
- GB-2: B-5898 x 750 mm x 750 mm “L” shaped grab bar beside water closet mounted as per OBC requirements.
- GB-3 B-5806 x 900 mm long bar at each side of urinal. Installed as per drawing.
- .2 All bars to have **concealed** mounting hardware.
- .3 Quantity: refer to drawings.
- .4 All bars to withstand horizontal and vertical pull of 2.2 kN

3. Vandal Resistant Clothes Hooks (CH): Model B-983

- .1 Stainless steel (SS)
- .2 Quantity: As noted on drawings. Mounting height to be 1200 mm max.

4. Stainless Steel Shelf (WSH): Bobrick B-295 x 400mm

Location: Universal Washroom and barrier-free stalls.

5. Toilet Tissue Dispenser (TPD): install only – Allow for installation of Owner supplied units.

6. Paper Towel Dispensers (PTD): Install only - Allow for installation of Owner supplied units.

7. Soap Dispensers: Not in Contract (NIC) - Allow for installation of Owner supplied units

8. Sanitary Napkin Disposal (ND): Not in Contract (NIC) - Allow for installation of Owner supplied units.

2.3 Component Minimum Requirements

- 1. **Construction:** Fabricate with materials, component sizes, metal gauges, reinforcing, anchors and fasteners of adequate strength to withstand intended use.
- 2. Where specified as frameless, provide stainless steel accessories with one-piece fronts having 90 degree formed returns at their edges and openings.
- 3. Where accessory fronts are framed, frame edges, both inside and outside, with 90 degree formed returns continuously welded and ground smooth at the corners. Doors shall also have 90 degree formed returns as specified.

4. Unless otherwise specified, hinges shall be semi-concealed stainless steel piano hinges extending full-length of hinged element. Provide hinged elements with concealed, mechanically-retained rubber bumpers for silent closing, and shall close flush with faces of fronts or frames.
5. Ensure that work will remain free of warping, buckling, opening of joints and seams, distortion and permanent deformation.
9. No exposed fixings permitted. Cut edges and openings square and smooth. Chamfer corners of edges and cut-outs 1.6 mm.
7. **Assembly:** Accurately cut, machine and fit joints, corners, copes and mitres so that junctions between components fit together tightly and in true planes.
8. Fasten work with concealed methods, unless otherwise indicated on Drawings.
9. Weld all connections where possible, bolt where not possible and cut off bolts flush with nuts. Countersunk bolt heads, and provide method to prevent loosening of nuts. Ream holes drilled for fastening.
10. Welded joints shall be tight, flush, and in true planes with base metals. Make welds continuous at joints where entry of water into voids of members or assemblies is possible.
11. Provide for differential movements within assemblies and at junctions of assemblies with surrounding work.
12. Welds in exposed locations shall be ground and polished smooth.
13. **Finish Work:** Provide holes and connections for related work installed under other Sections of this specification, if applicable.
14. Cleanly and smoothly finish exposed edges of materials, including holes.

PART 3 - EXECUTION

3.1 Inspection of Site

1. Take site measurements to ensure that work is fabricated to fit surrounding construction around obstructions and projects in place, or as shown on drawings, and to suit service locations.

3.2 Installation

1. Install all accessories in accordance with manufacturers' instructions at their recommended mounting heights unless noted otherwise on drawings.

2. Securely fasten accessories plumb, true, square, straight, level, and accurately and tightly fitted together and to surrounding work. Install in locations shown and specified herein. Mounting heights as shown or in accordance with the OBC in the case of barrier-free accessories.
3. Work shall include anchor bolts, bolts, washers and nuts, lag screws, expansion shields, toggles, straps, sleeve brackets, clips, and other items necessary for secure installation, as required by loading and by Jurisdictional Authorities.
4. Attach work at wood by screws through countersunk holes in metal.
5. Attach work to masonry with lead plugs and non-corrosive fastenings, to support load with a safety factor of 3. Perform all drilling necessary to install the work.
6. Insulate between dissimilar metals or between metals and masonry or concrete with bituminous paint, to prevent electrolysis.
7. Coordinate installation with the work of other trades adjacent to accessories to achieve the reveals or other edge conditions shown, where their front faces are flush with the finished wall surfaces.
8. Owner to supply and install remainder of washroom accessories not specified here (toilet paper dispensers, etc.). Cooperate with Owner as required.

3.3 Cleaning Up and Adjustment

1. Upon completion of the work, or when directed, remove all traces of protective coatings or paper.
2. Test mechanisms, hinges, locks and latches, and where necessary, adjust and lubricate and ensure that accessories are in perfect working order.

End of Section

PART 1 - GENERAL

1.1 Scope

1. To furnish all labor, materials and equipment necessary or required to fully complete the installation of the elevator and lifts as shown on the drawings and specifications. This suggested specification is intended to cover the complete installation of:
Garaventa Elvoron LULA Elevator

1.2 System Description

1. The elevator assembly shall consist of a power unit, car, rail guide system, 1:2 cable hydraulic lifting device, hoist way doors, car doors, control system, signals and alarms, electrical wiring, and parts and accessories necessary to provide required performance, operation, code and safety requirements.

1.3 Quality Assurance

1. The elevator shall meet or exceed the applicable regulations of all governing agencies and be in compliance with the applicable sections of the most current edition of the following codes and standards:
 - .1 ASME A17.1 "Safety Code for Elevators and Escalators, Limited Use/Limited Application Elevators".
 - .2 CSA B44-00 "Safety Code for Elevators, Section 5.2 Limited Use/Limited Application Elevators"

Note: ASME A17.1 & CSA B44 contain harmonized requirements.

 - .3 ICC/ANSI A117.1-1998 "Accessible and Usable Buildings and Facilities".
 - .4 ANSI/NFPA 70-1999 "The National Electric Code" (NEC).
 - .5 ADAAG "Americans With Disabilities Act Accessibility Guidelines" (where applicable).
 - .6 CSA B44.1/ASME A17.5 "Elevator and Escalator Electrical Equipment".
 - .7 Local codes and regulations, as applicable.
2. Requirements of the Regulatory Agencies:
 - .1 Fabricate and install Work in compliance with all applicable jurisdictional authorities.
 - .2 File shop drawings and submissions to local authorities as the information is made available. Company pre-inspection and jurisdictional authority inspections and permits are to be made on a timely basis as required. Work will include all inspections and re-inspections that are required to ensure licenses are issued.

3. Subcontractor Qualifications:

- .1 Execute work of this specification only by a contractor/company who has adequate product and public liability insurance in excess of one million dollars.
- .2 Skilled tradesmen must be employees of the contractor to perform the work on a timely basis. Employees must be trained by the manufacturer and be supervised by the elevator contractor.

PART 2 – PREPARATORY WORK BY OTHER TRADES

2.1 The following preparatory work to accommodate/receive the elevator is to be done by other trades:

1. Power unit machine room to meet applicable codes and standards.
2. Permanent power to operate the lift to be provided to a lockable fused/cartridge type disconnect switch with auxiliary contact/switch for emergency battery lowering. Provide 110-volt lighting supply and disconnect. Refer to architectural drawings for permanent power specifications and location of the disconnects.
3. Provide appropriate sleeves for both the electrical conduit and hydraulic line from the power unit enclosure to the hoistway (as shown on drawings). Trenching may be required if the machine room is not adjacent to hoistway.
4. Provide machine room light and light switch, located to comply with applicable codes and standards.
5. Provide an enclosed, plumb and square hoistway with smooth interior surfaces. Include for fascias or furring of hoistway interior where applicable.
6. Suitable lintels over landing entrances are to be provided and provide rough openings as per elevator contractors' shop drawings.
7. Provide substantially level pit floor slab to support loads indicated on the elevator contractors' shop drawings.
8. Provide adequate support for guide rail fastenings.
9. Provide light, receptacle and switch in the pit, located to comply with applicable code.
10. Provide pit water proofing or sump pump, if required, as allowed by code.
11. Provide pit ladder for pits 3'-0" (914 mm) or more in depth.
12. Provide finish grouting and masonry around doorframes.

PART 3 - SUBMITTALS

3.1 Shop Drawings

1. The shop drawings shall show a complete layout of the elevator equipment detailing dimensions, clearances and location of machinery. Including, but not limited to, the following:
 - .1 Drawings showing the dimensions including plans, elevations, and sections to show equipment locations.
 - .2 Load and reaction drawings shall be provided by the elevator manufacturer and detailed on drawings.

PART 4 - PRODUCT DATA

4.1 Manufacturer/Product

Elevator shall be based on the Hydraulic Drive Garaventa ELVORON LU/LA
Acceptable Equal: Thyssen, Federal and Cambridge Elevator-Commercial
Delta Elevator: Delta 9000 – Model 4854F

Rated Load:	1,400 lbs. (635 kg.)
Rated Speed:	30 fpm (0.15 m/s)
Car Dimensions:	48" W x 54" L Depth (1220 mm x 1372mm)
Operation:	Single Automatic Push Button
Power Supply:	220-Volt, Single Phase, 60 Amp or 208-Volt, 3 Phase, 30Amp.
Travel Distance:	4.0m (13.12 feet +/-)
Levels Served:	2
Number of Openings:	1
Lighting Supply:	110-Volt, Single Phase, 60 cycle, 15 amps
Door Opening:	36" x 6' 8" (914x 2030 mm) Nominal
Jack Type:	1:2 cable hydraulic
Pump Type:	Screw Pump with Variable Speed Valve
Hoistway Door/Cab Door:	2-Speed Horizontal Sliding Hoistway Doors with 2-Speed Horizontal Sliding Cab Door
Car Controller Type:	Tape Head Reader
Leveling Device Type:	Tape Head Reader

4.2 Signage

1. The elevator shall have all necessary signs, capacity plates, and data signs as per the local and national Codes and Standards.
2. A capacity plate indicating the rated load in pounds and kilograms and operating instructions shall be furnished by the manufacturer and fastened in a prominent place at

each landing and in the cab. The capacity plate and operating instructions will be engraved on non-glare, micro-surface, white letters on a blue background, self-adhesive, flexible plastic material. The letters and figures stating the capacity shall not be less than 1/4" in height.

4.3 Fully Automatic Operation

1. The operation shall be single automatic push button. Each landing shall be equipped with a single light up button/digital floor indicator and audible arrival chime. Upon momentary pressure of the landing or car button, the call shall register in the control system and remain in memory until answered.

4.4 Car Enclosure

1. **Walls:**
Steel cab with 3/4" (19 mm) clip-on fire rated laminated panels. Painted cab frame reveal to be standard black or architectural white. Clip-on Panel selected from standard plastic laminate selection.
2. **Ceilings:**
Non-removable Hi Gloss Architectural white painted baked enamel steel ceiling with 4 incandescent down lights
3. **Floor:**
Steel frame and flooring with plywood sheeting. Flooring to receive porcelain tile as per finish schedule (NIC). Supply and installed by **flooring contractor**.
4. **Handrail:**
One (1) stainless steel handrail shall be located on control wall of the cab.
5. **Emergency Operation:**
The car shall be equipped with a battery powered emergency lowering and door opening device and alarm which is automatically actuated in the event of failure of the normal building power supply. Battery will be rechargeable with an automatic recharging system.
6. **Emergency Lighting:**
In the event of a main power supply failure, an integral, battery powered emergency light will provide cab lighting.
7. **Tactile Plates:**
Provide metal tactile plates 1 1/4" X 1 1/4" on the cab control panel beside the appropriate button indicating the floor number and/or function. Also provide metal tactile plates 3" X 4" at each floor located on the doorjamb indicating the appropriate floor number.

8. Car Operating Panels

Car operating panel shall be hinged and shall consist of metal push button with halo lighting for each landing, emergency alarm, keyed stop switch, door open and close buttons all mounted on (#4 finished). Stainless steel panel. The car-operating panel will be engraved with Fireman Service instructions.

9. Car Travel Lanterns

Provide a visual indicator to indicate the direction of travel of the car and audio signal upon floor arrival.

10. Digital Floor Indicator

A digital floor indicator located in the control panel will display the location (floor number) of the elevator in the shaft as well as the direction of travel.

11. Car Lighting

The car lighting shall consist of four- (4) low voltage incandescent down lights. The failure of one lamp shall not cause the remaining lamps to extinguish.

12. Automatic Lights

Overhead lights in the car compartment shall turn ON automatically when the elevator door is opened and stay ON while the elevator is in use. The elevator lights will shut OFF by a timer when the elevator is not in use.

13. Key Operation and Lock Out

4.5 Platform Toe Guard

1. A platform toe guard shall be provided at each car entrance opening to extend below car entrance opening for safety.

4.6 Leveling Device

1. The elevator shall be provided with a 2 way-leveling device, which will maintain the car within 1/2" (13 mm) of the landing, by magnetic sensor.
2. Leveling device switches shall be located in a position to be inaccessible to unauthorized persons.
3. Hoistway car position signals shall be magnetically sensed for quiet operation.

4.7 Two Speed Horizontal Sliding Hoistway Door/Cab Gate

1. Cab Door Operation
 - .1 Power operated, two speed horizontal sliding, zinc wipe coated, steel panels providing a clear opening of 36" x 80" (914 mm x 2032mm) shall be provided.
 - .2 Doors on the car and at the hoistway entrances shall be power operated by means of a solid-state 24 volt D.C. operator with smooth quiet belt drive

transmission, operable during power failure.

- .3 Door operation shall be automatic at each landing with door opening being initiated as the car arrives at the landing and closing taking place after expiration of an adjustable time interval.

A key operation system to be included for shutting off access to each level separately.

- .4 All control adjustments shall be potentiometer regulated.
- .5 The door shall be equipped with an infrared self-contained light curtain that will stop and reverse the doors should it detect an obstacle.
- .6 The car doors shall be equipped with a master door clutch to control the individual landing door electrical-mechanical interlocks.
- .7 The car door electric contact shall prevent the elevator from moving away from the landing unless the car door is in the closed position and the controller will monitor the door contacts and register a fault if any have been bypassed.
- .8 The car doorsill shall be extruded aluminum.

2. Hoistway Doors

- .1 Two speed horizontal sliding, zinc wipe coated, steel panels providing a clear opening of 36" (914 mm) x 80" (2032 mm) shall be provided at each landing.
- .2 Frames shall be of bolted construction for a one-piece unit assembly comprised of head and side jamb sections.
- .3 The door assembly shall be 1 1/2 UL/ULC labeled and provided with approved electrical mechanical interlocks.
- .4 The landing doorsill shall be extruded aluminum with non-slip wearing surfaces and grooves for door guides.

4.8 Hydraulic Power Unit

- 1. The pump and motor shall be the submersible type installed inside the oil tank.
- 2. The controller shall be integrally mounted on the power unit frame.
- 3. Control circuitry to be Programmable Logic Controls and be located on the pump unit.
- 4. The power unit control valve shall be a variable speed proportional valve type that includes all hydraulic control valving inherently. This valve shall incorporate the following features:
 - .1 Up and down acceleration and deceleration speed adjustment for a smooth starts and stops.
 - .2 Smooth stops at each landing shall be an inherent feature of the valve.
 - .3 Adjustable pressure relief valve.
 - .4 Manually operating DOWN valve to lower elevator in an emergency.
 - .5 Pressure gauge indicating in P.S.I. and Bars.
 - .6 Gate valve to isolate cylinder from pump unit.
 - .7 Negative pressure switch

4.9 Negative Pressure Switch

1. In addition to the standard operating features of the hydraulic control valve, there shall be a pressure sensitive check valve that will activate when negative pressure is sensed in the hydraulic system. The check valve will close and stop the hydraulic jack from descending immediately on sensing negative pressure.

4.10 Cylinder and Plunger

1. The cylinder shall be constructed of steel pipe of a sufficient thickness and suitable safety margin. The top of the cylinder shall be equipped with a cylinder head with an internal guide ring and self-adjusting packing.
2. The plunger shall be constructed of a steel shaft of a proper diameter machined true and smooth. The plunger shall be provided with a stop electrically welded to the bottom to prevent the plunger from leaving the cylinder.

4.11 Cable

1. Minimum of two 3/8" (10 mm).

4.12 Safety Device

1. A "slack/broken cable" safety device shall be supplied, which will stop and sustain the elevator and its rated load, if either of the hoisting cables becomes slack or breaks. The safety device shall be resettable by the operation of the elevator in the upward direction. A switch shall be mounted in such a position to sense the operation of the safety device, and will open the safety circuit to the controller to prevent operation of the elevator in either direction.

4.13 Guide Yoke

1. The 1:2 guide yoke/sheave arrangement shall be supplied with a sheave, guide shoes, roller bearings and adjustable cable guards. The sheave shall be finished with rounded grooves to fit the cables.

4.14 Normal Terminal Stopping Devices

1. Normal terminal stopping devices shall be magnetically sensed at the top and bottom of runway to stop the car automatically.

4.15 Guide Rails and Brackets

1. Steel 8lb/ft "T" guide rails and brackets shall be securely fastened to the building structure.
2. Brackets shall securely hold the guides in a plumb and true position regardless of car loading.

3. Guides shall be bolted through the hoistway enclosure with “back-up” plates, washers and nuts. Subject to Architect’s alterations and approvals.

4.16 Car Sling

1. Car sling shall be fabricated from steel members with adequate bracing to support the platform and cab.
2. The buffer-striking member on the underside of the car must stop the elevator before the plunger reaches its down limit of travel.
3. Guide shoes to be solid slipper type with polyurethane inserts.

4.17 Overspeed Governor

1. Elevator to be equipped with an overspeed governor complete with tension weight and brackets; high strength wire rope and attachment fittings, all in conformance with the applicable code sections. The governor shall be traction driven, self-resetting, field adjustable and be provided with a means to seal the tripping speed.

4.18 Car Top Inspection Station

1. Provide a car top inspection station consisting of a stop button and constant pressure Up and DOWN button. The car top control will override all other controls. Also provide a 110-volt GFI outlet socket and light.

4.19 Wiring

1. All wiring and electrical connections shall comply with applicable Codes, insulated wiring shall have flame retardant and moisture proof outer covering and shall be run in a conduit or electrical wireways. Traveling cables shall be flexible and suitably suspended to relieve strain.

PART 5 - EXECUTION

5.1 Examination

1. All site dimensions shall be taken to ensure that tolerances and clearances have been maintained and meet local regulations.

5.2 Preparation

1. Pre-inspect the construction and service requirements for “Work by Others.” These requirements will be included in drawings, diagrams, engineering data sheets and special instructions before the work commences.

PART 6 - WARRANTY

6.1 Warranty

1. The entire elevator and all component parts shall carry a LIMITED WARRANTY for a period of Two (2) Year from the date of Substantial Completion. The warranty shall be for the replacement at no cost of defective parts including all labour costs associated with their replacements. **Manuf to Allow for extended warranty of and additional five (5) years. (7 years total warranty).**

PART 7 - OWNER’S INSTRUCTION & MANUAL

7.1 Owner’s Instruction & Manual

1. After installation is completed, the contractor shall instruct the owner in the proper use, operation and maintenance requirements of the elevator. Instructions also include emergency procedures and safety rules and precautions. The contractor shall also supply the owner with an Owner’s Manual detailing the operating, safety, and maintenance procedures of the elevator.

End of Section

Index of Architectural Detail Drawings

214	Construction Job Site Signage Detail
214A	Construction Job Site Signage Detail
401	Wall Control Joint Detail Interior Side
401A	Interior Expansion Joint Detail
425	Expansion Joint Detail
600	Millwork Type B1
600A	Millwork Type B2
601	Millwork Type U1
602	Millwork Type T1
602A	Millwork Type T1 Section A
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603	Millwork Type MM1 – Workstation Desks
603A	Millwork Type MM1 - Section Detail
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605	Millwork Type MM2 – Section Detail
606	Millwork Type MM3 – Workstation Island
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700	Roof Curb Detail
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702	Roof Expansion Joint Detail
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704	Low Papapet Wall Detail
705	Vent With Stack Jack Detail
706	Wall Flashing Reglet Detail
707	Wall Flashing With Metal Cladding
900	Vinyl/ Rubber Base Detail
901	Porcelain Tile Base Detail

End of Section

ELEVATION

SCALE: 1:25

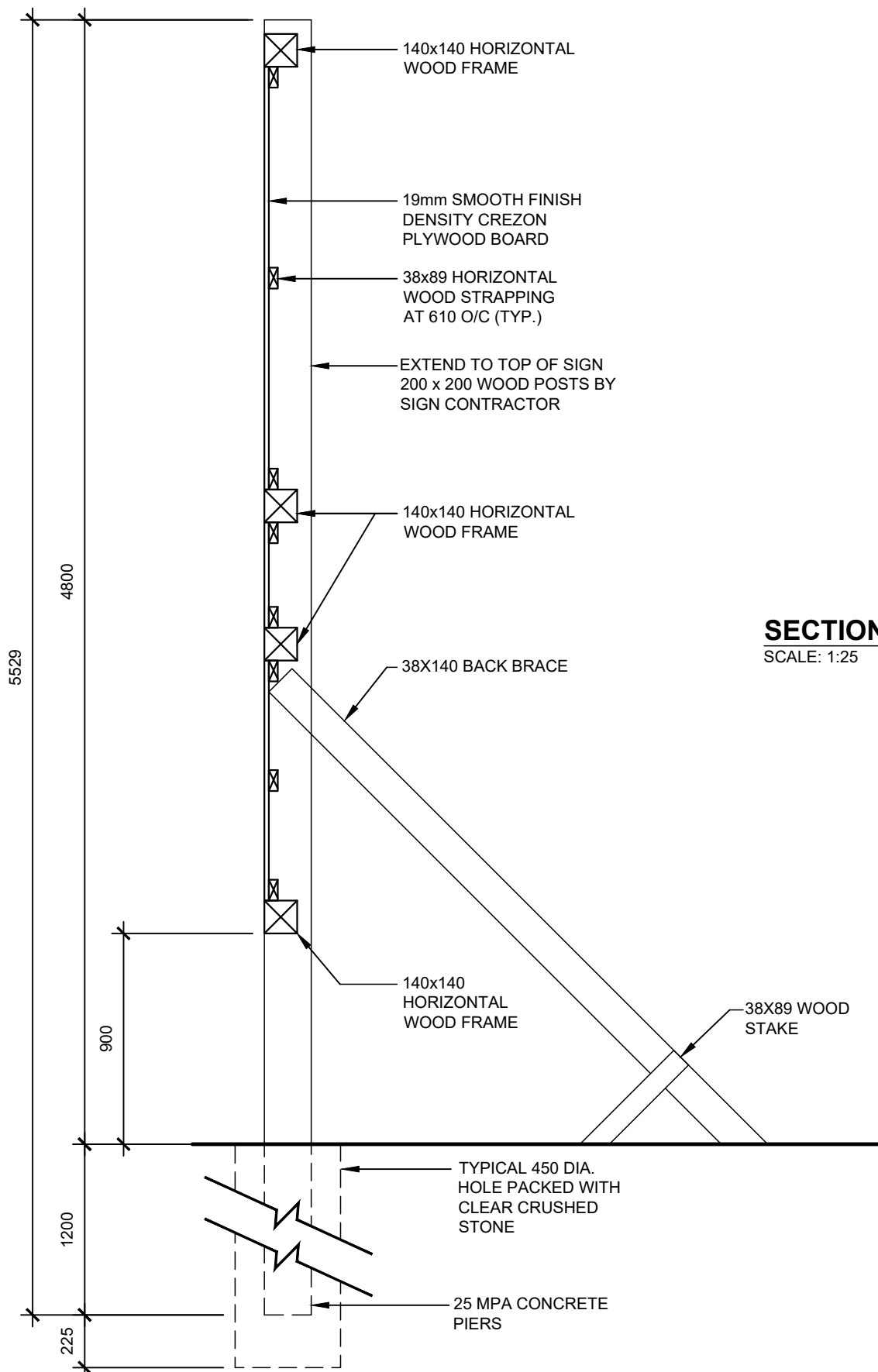


**ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL
ADDITION**
504 CONNAUGHT STREET, KITCHENER, ON.
CONSTRUCTION JOB SITE SIGNAGE DETAIL

PROJ: 2025-06
SCALE: AS NOTED
DRAWN: R.P.
DATE: 2025-09-30

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**AD
214**



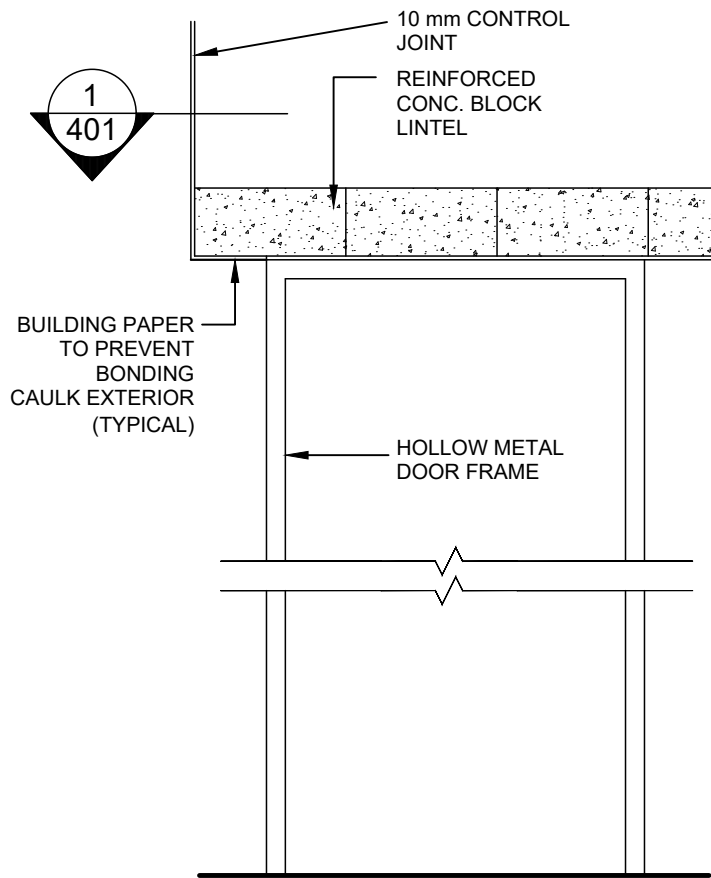
SECTION
SCALE: 1:25

ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.
CONSTRUCTION JOB SITE SIGNAGE DETAIL

PROJ: 2025-06
SCALE: AS NOTED
DRAWN: R.P.
DATE: 2025-09-30

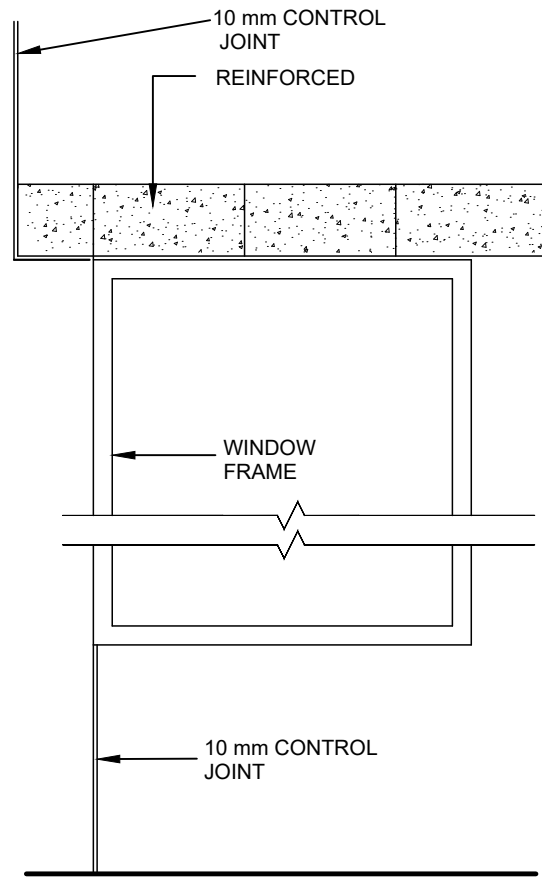
**GRGURIC
ARCHITECTS
INCORPORATED**
Web: www.2gai.com

**AD
214A**



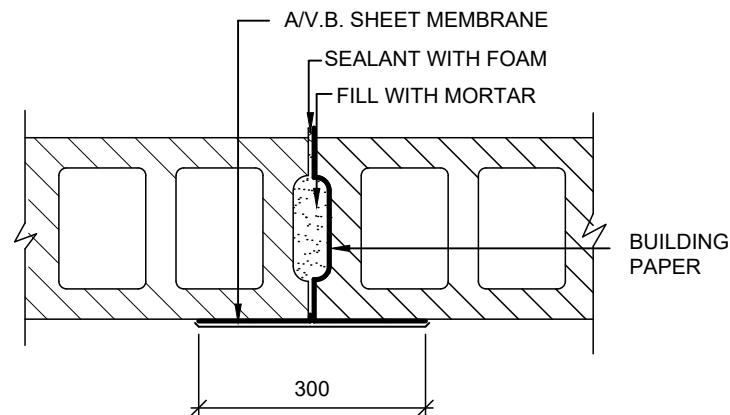
DOOR CONTROL JOINT

SCALE 1 : 20



WINDOW CONTROL JOINT

SCALE 1 : 20



PLAN DETAIL

SCALE 1 : 10



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.

**WALL CONTROL JOINT DETAIL
INTERIOR SIDE**

PROJ: 2025-06

SCALE: AS NOTED

DRAWN: R.P.

DATE: 2025-09-30

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Web: www.2gai.com

**AD
401**

LOCATION OF EXPANSION JOINTS
TO BE PROVIDED BY ARCHITECT DURING CONSTRUCTION
(REFER TO SPEC)

CONTINUOUS EXTRUDED
WALL JOINT COVER

125

RUBBER GASKET

2" WIDE ALUMINUM
ANCHOR CLIP 24" O.C.

10 x 1/2" WOOD SCREW
AND RAWL PLUG 24" O.C.

25
MIN.

ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.

INTERIOR EXPANSION JOINT DETAIL

PROJ: 2025-06

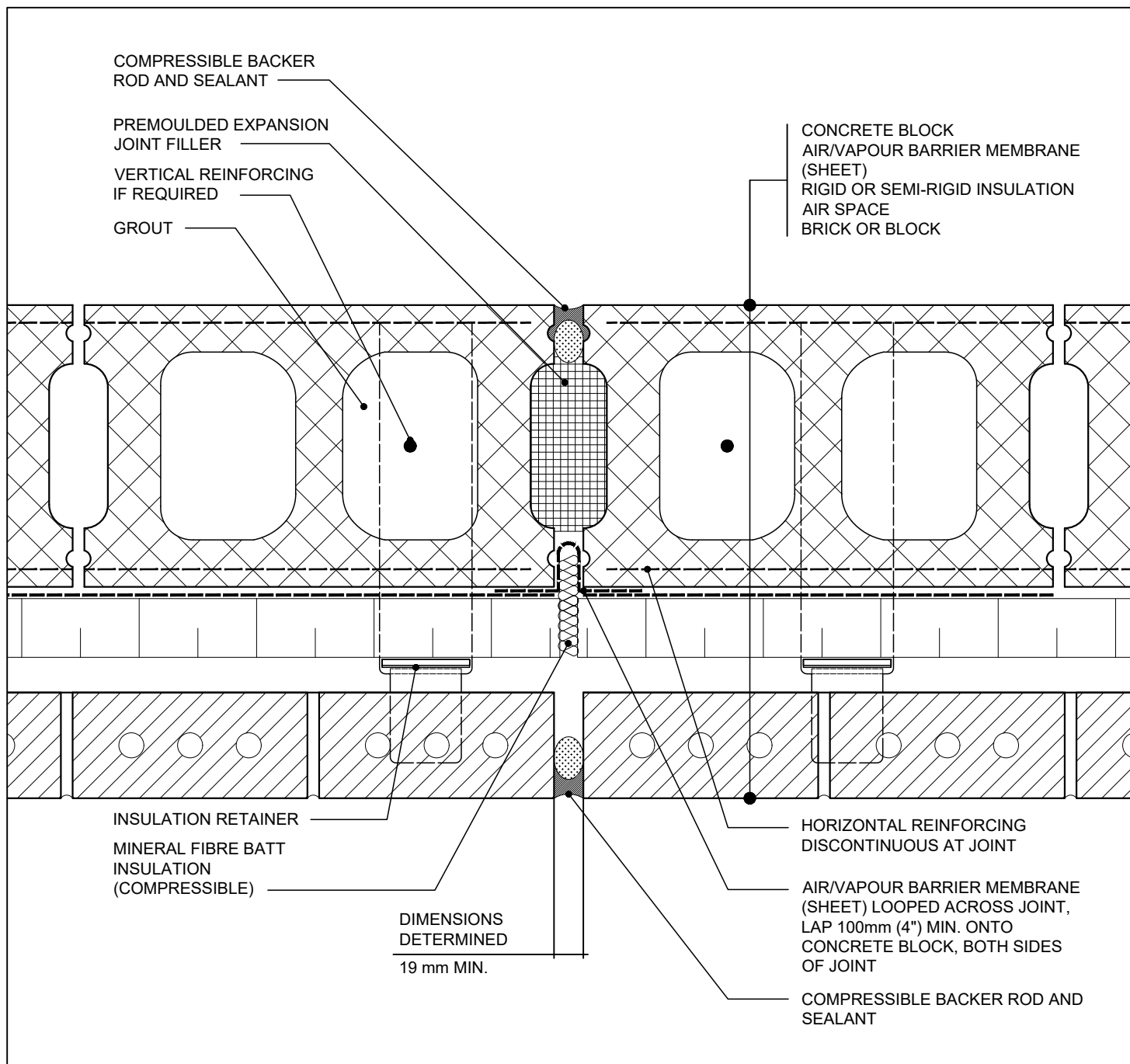
SCALE: AS NOTED

DRAWN: R.P.

DATE: 2025-09-30

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Web: www.2gai.com

**AD
401A**



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.

**EXPANSION JOINT
DETAIL**

PROJ: 2025-06

SCALE: AS NOTED

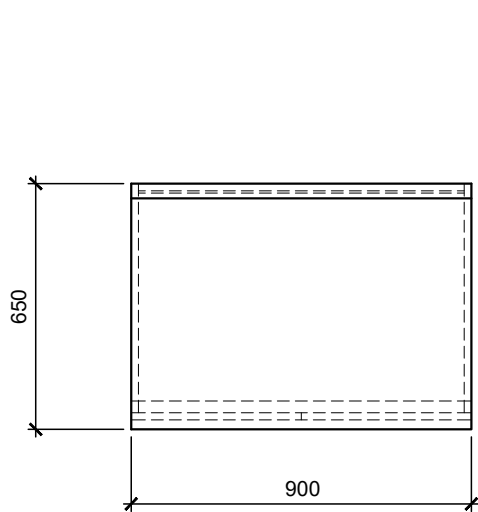
DRAWN: R.P.

DATE: 2025-09-30

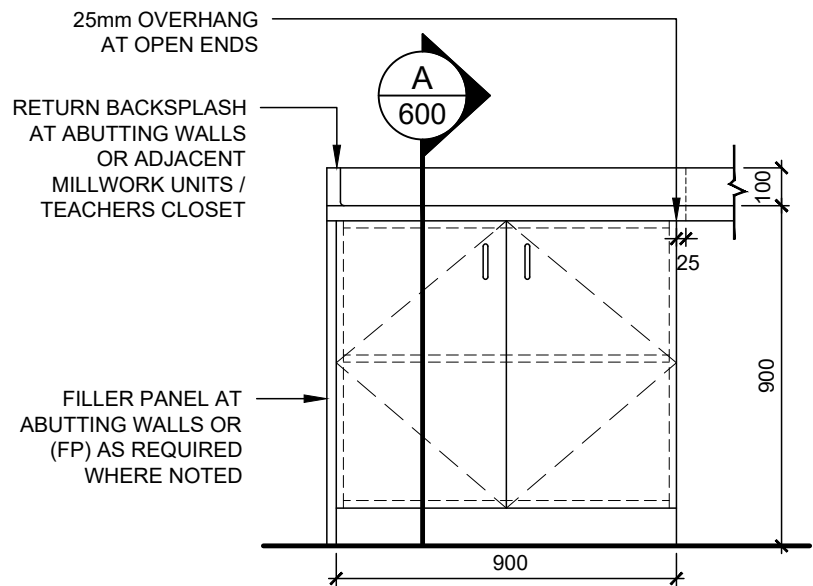
**GRGURIC
ARCHITECTS
INCORPORATED**

Web: www.2gai.com

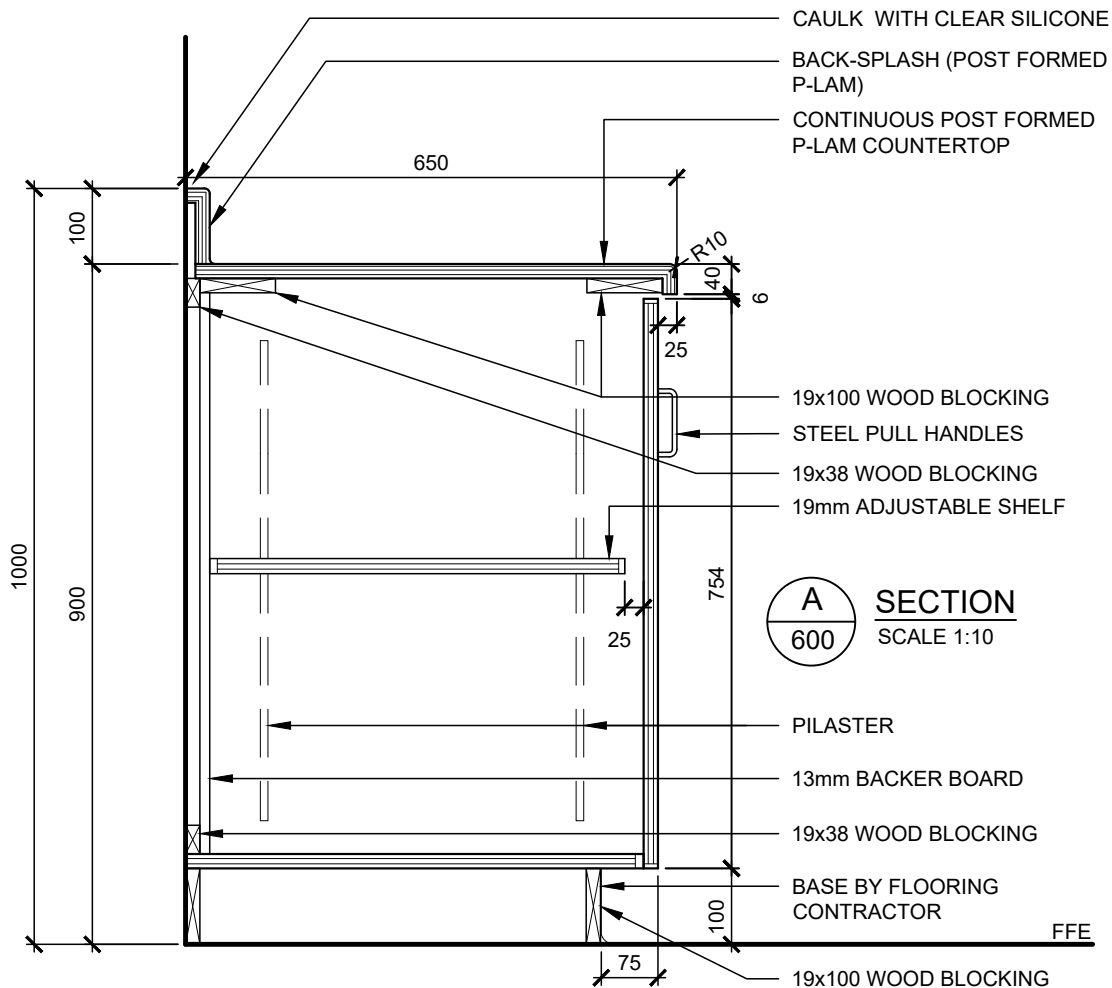
**AD
425**



PLAN VIEW
SCALE 1:20



ELEVATION
SCALE 1:20



SECTION
SCALE 1:10

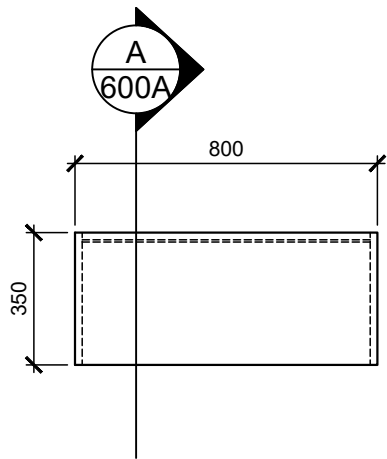
ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.
MILLWORK TYPE B1
(REFERENCE: A2.00 / A2.10)

TYPICAL NOTE: MILLWORK IS 19mm CONSTRUCTION UNLESS OTHERWISE NOTED.
REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES

PROJ: 2025-06
SCALE: AS NOTED
DRAWN: R.P.
DATE: 2025-09-30

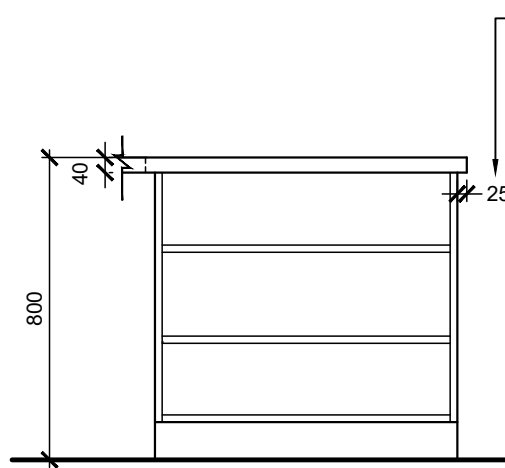
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ARCHITECTS
INCORPORATED
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AD
600



PLAN

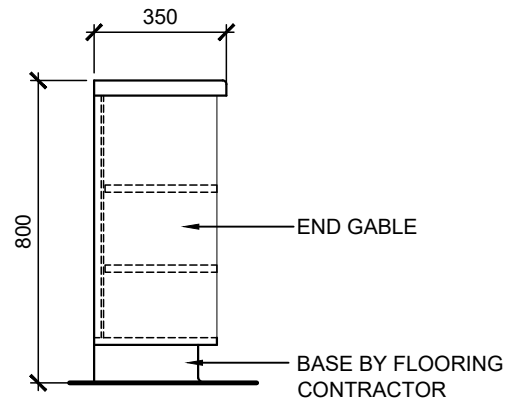
SCALE 1:20



ELEVATION

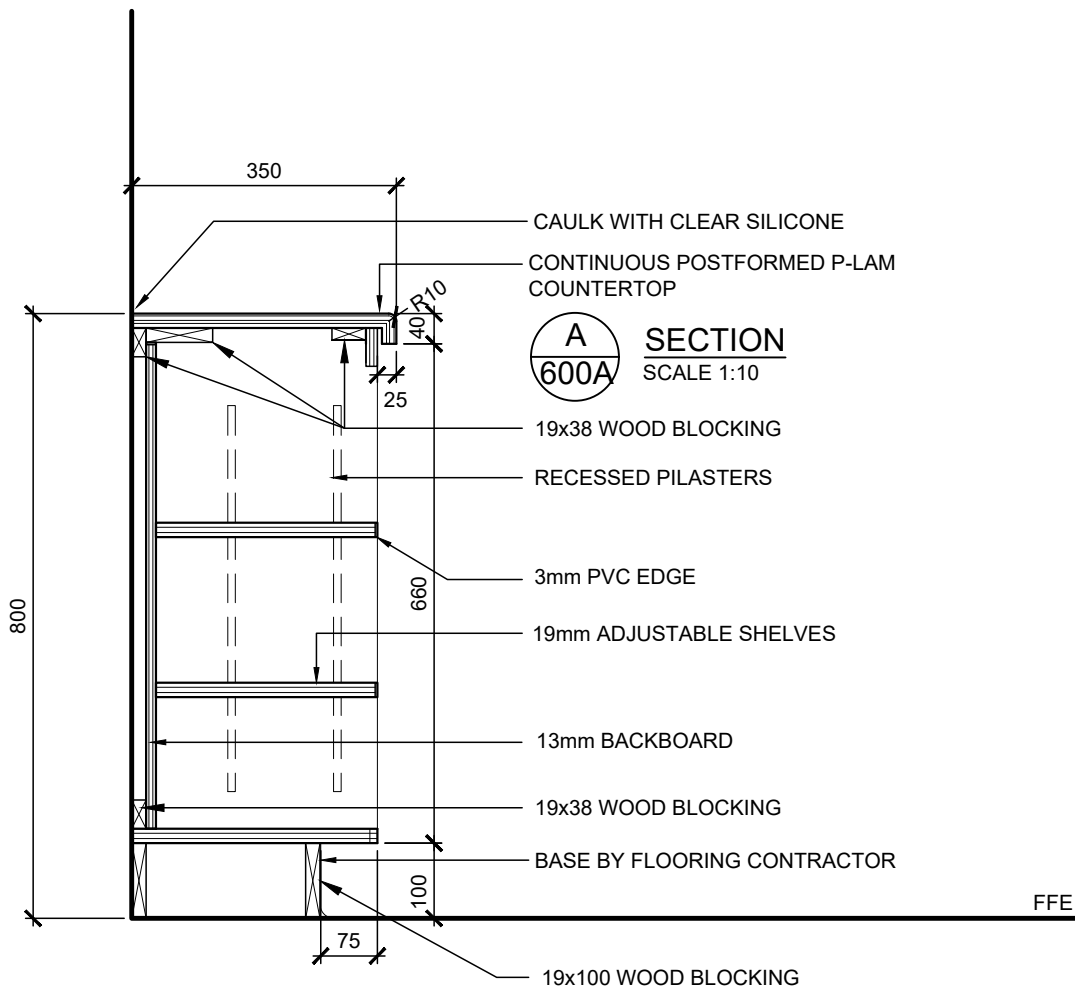
SCALE 1:20

25mm OVERHANG
AT OPEN ENDS ONLY



SIDE ELEVATION

SCALE 1:20



A
600A

SECTION

SCALE 1:10

FFE

ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.
MILLWORK TYPE B2
(REFERENCE: A2.00 / A2.10)

TYPICAL NOTE: MILLWORK IS 19mm CONSTRUCTION UNLESS OTHERWISE NOTED.
REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES

PROJ: 2025-06

SCALE: AS NOTED

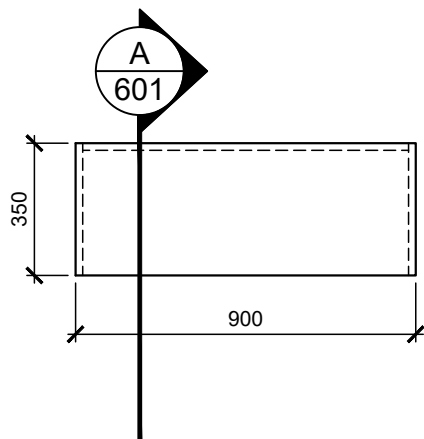
DRAWN: R.P.

DATE: 2025-09-30

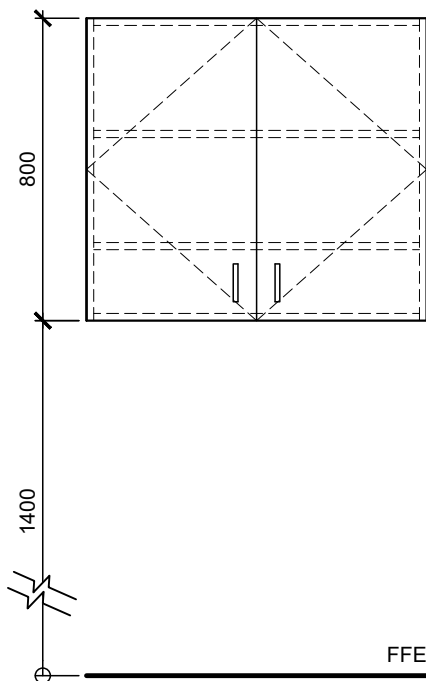
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Web: www.2gai.com

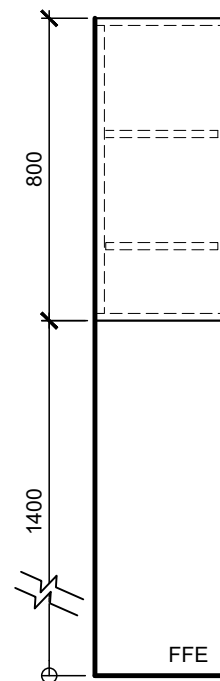
AD
600A



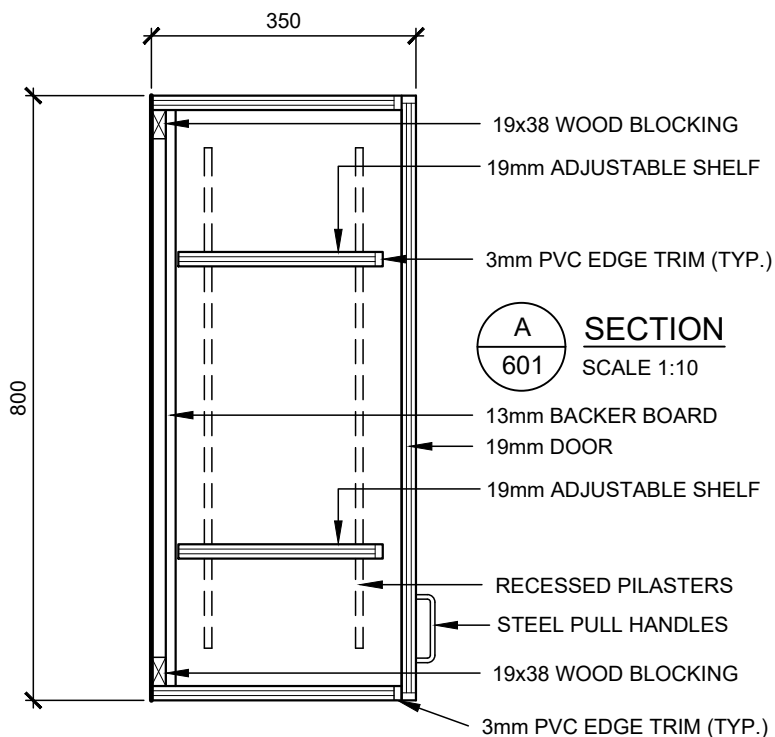
PLAN
SCALE 1:20



ELEVATION
SCALE 1:20



SIDE ELEVATION
SCALE 1:20



SECTION
SCALE 1:10

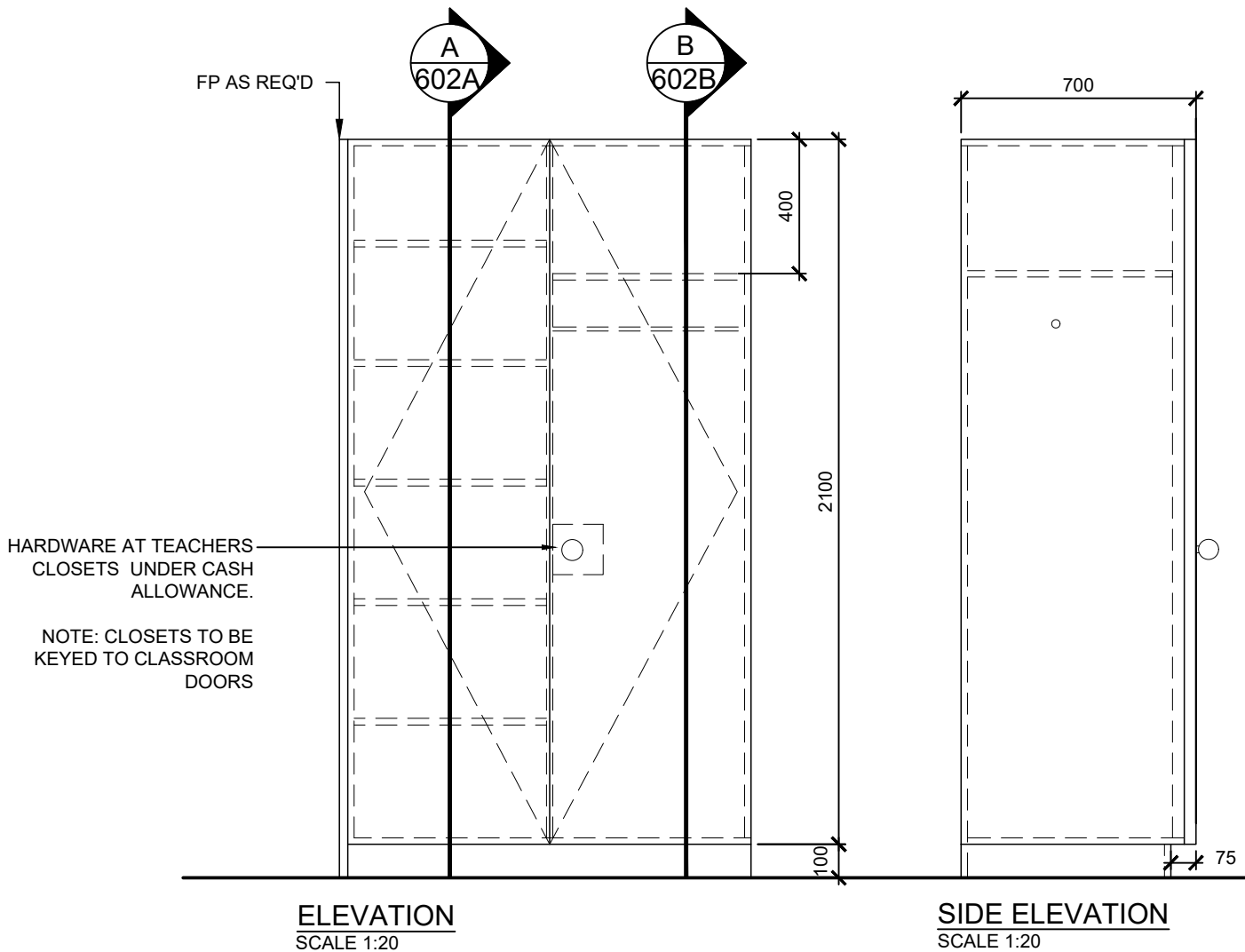
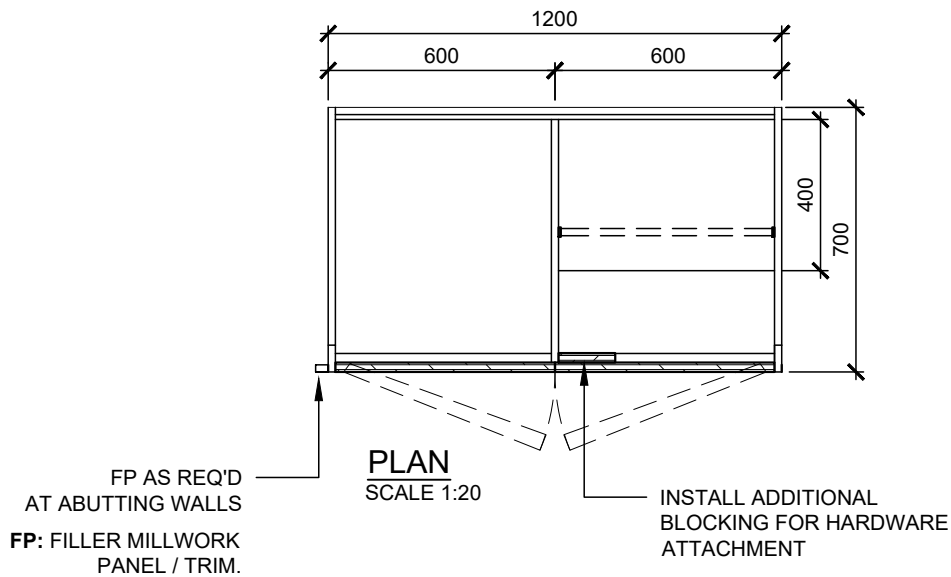
ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.
MILLWORK TYPE U1
(REFERENCE: A2.00 A2.10)

TYPICAL NOTE: MILLWORK IS 19mm CONSTRUCTION UNLESS OTHERWISE NOTED.
REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES

PROJ: 2025-06
SCALE: AS NOTED
DRAWN: R.P.
DATE: 2025-09-30

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**AD
601**



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.
MILLWORK TYPE T1
(REFERENCE: A2.00, A2.10)

TYPICAL NOTE: MILLWORK IS 19mm CONSTRUCTION UNLESS OTHERWISE NOTED.
REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES

PROJ: 2025-06

SCALE: AS NOTED

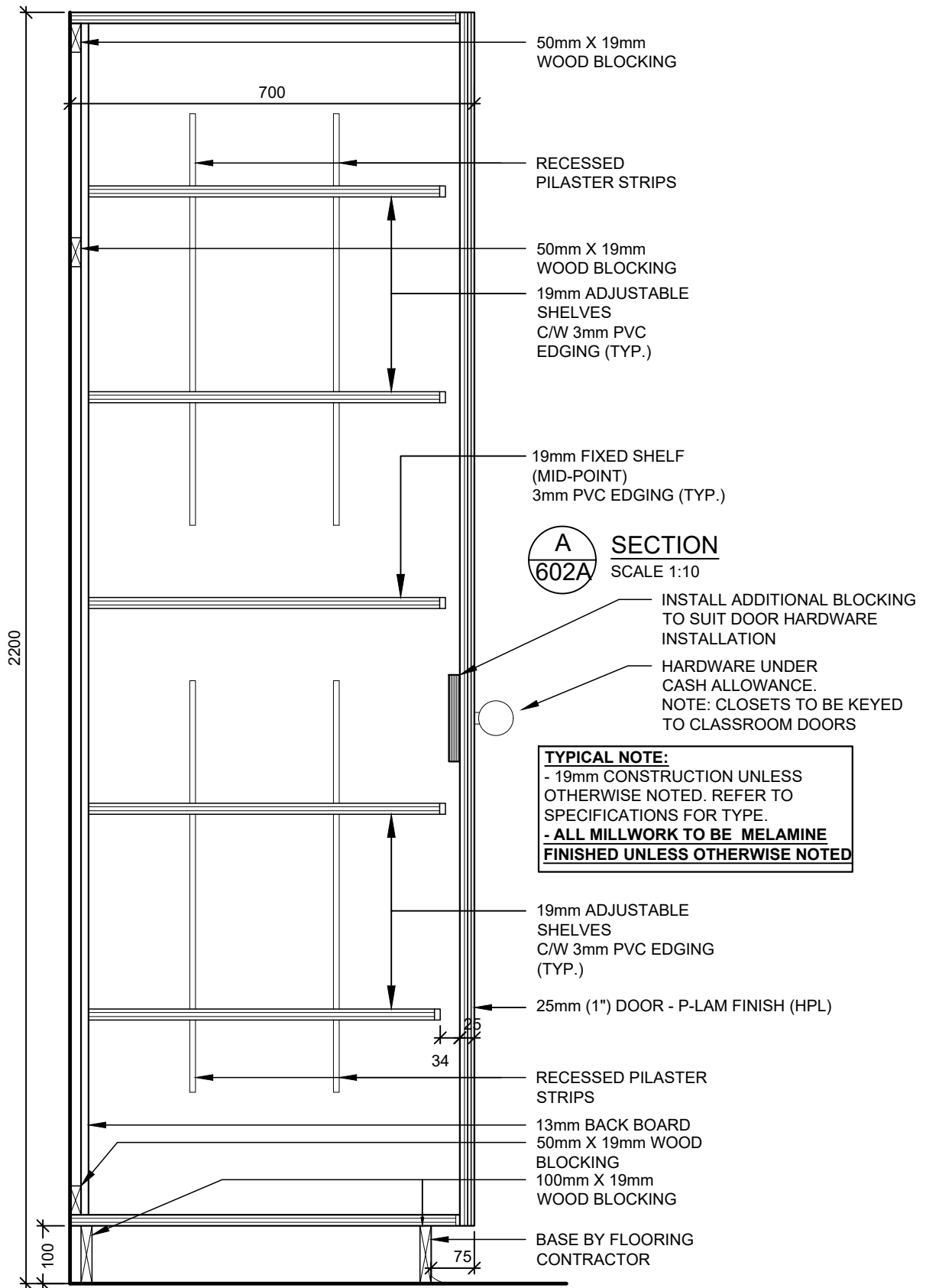
DRAWN: R.P.

DATE: 2025-09-30

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**AD
602**



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.
MILLWORK TYPE T1 SECTION A
(REFERENCE: AD602)

TYPICAL NOTE: MILLWORK IS 19mm CONSTRUCTION UNLESS OTHERWISE NOTED.
REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES

PROJ: 2025-06

SCALE: AS NOTED

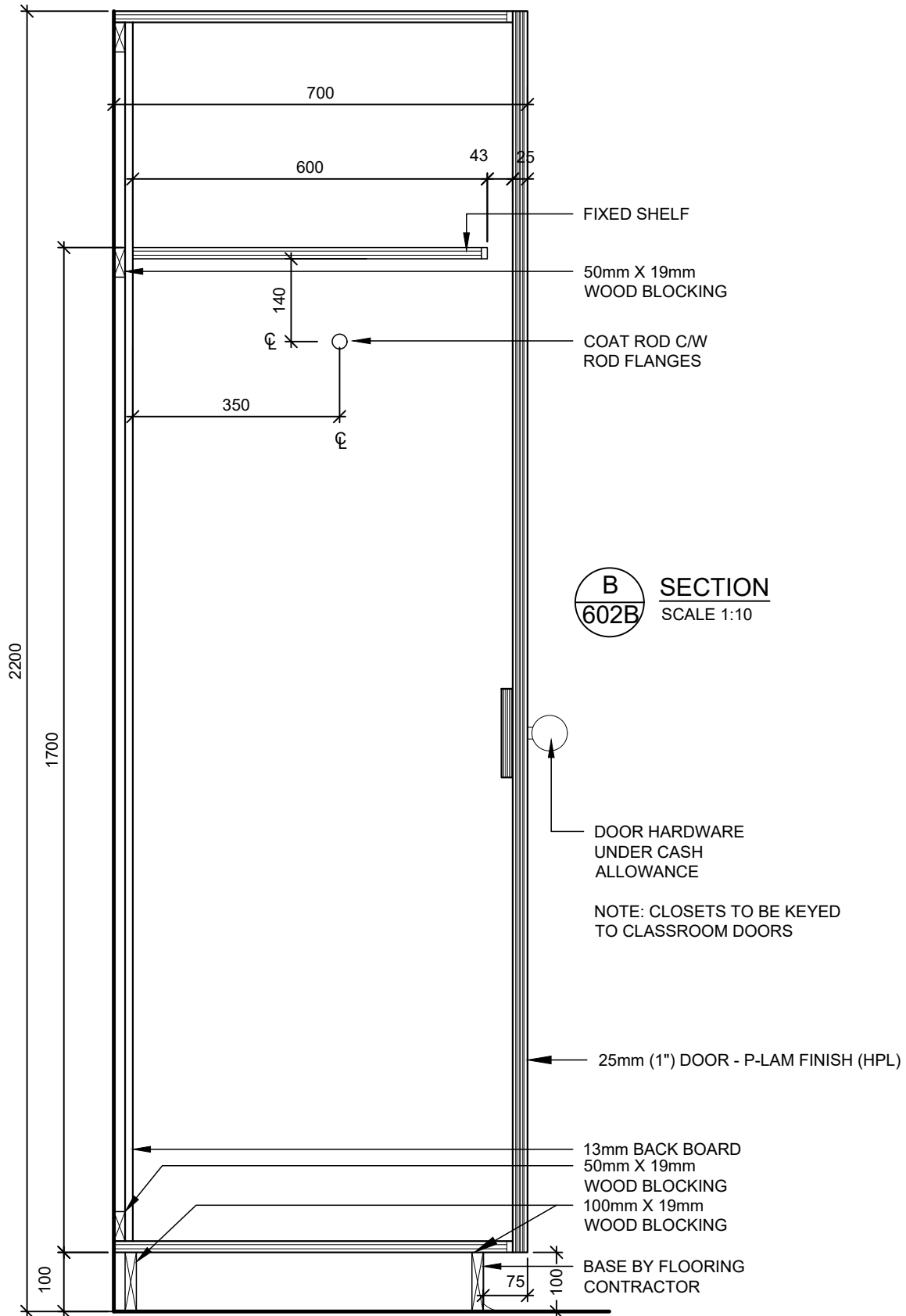
DRAWN: R.P.

DATE: 2025-09-30

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**AD
602A**



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.
MILLWORK TYPE T1 SECTION B
(REFERENCE: AD602)

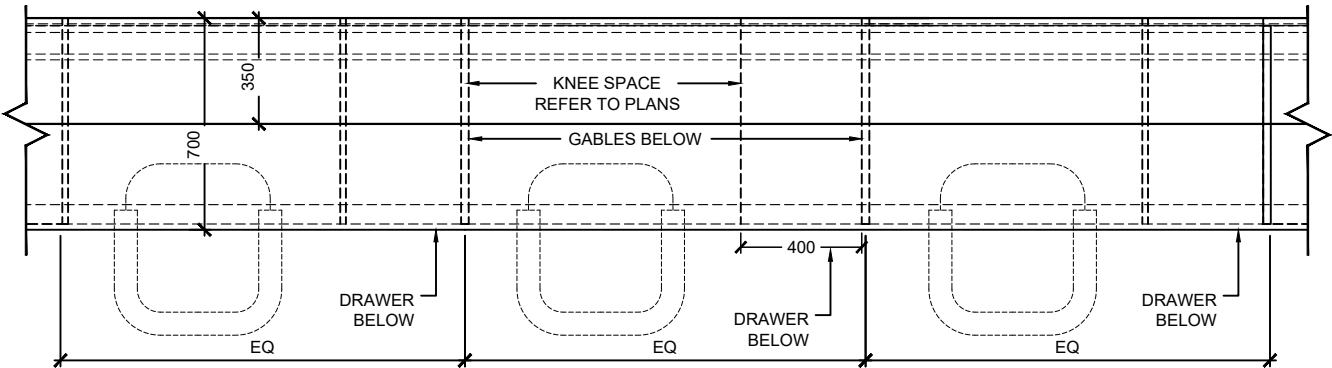
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REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES

PROJ: 2025-06
SCALE: AS NOTED
DRAWN: R.P.
DATE: 2025-09-30

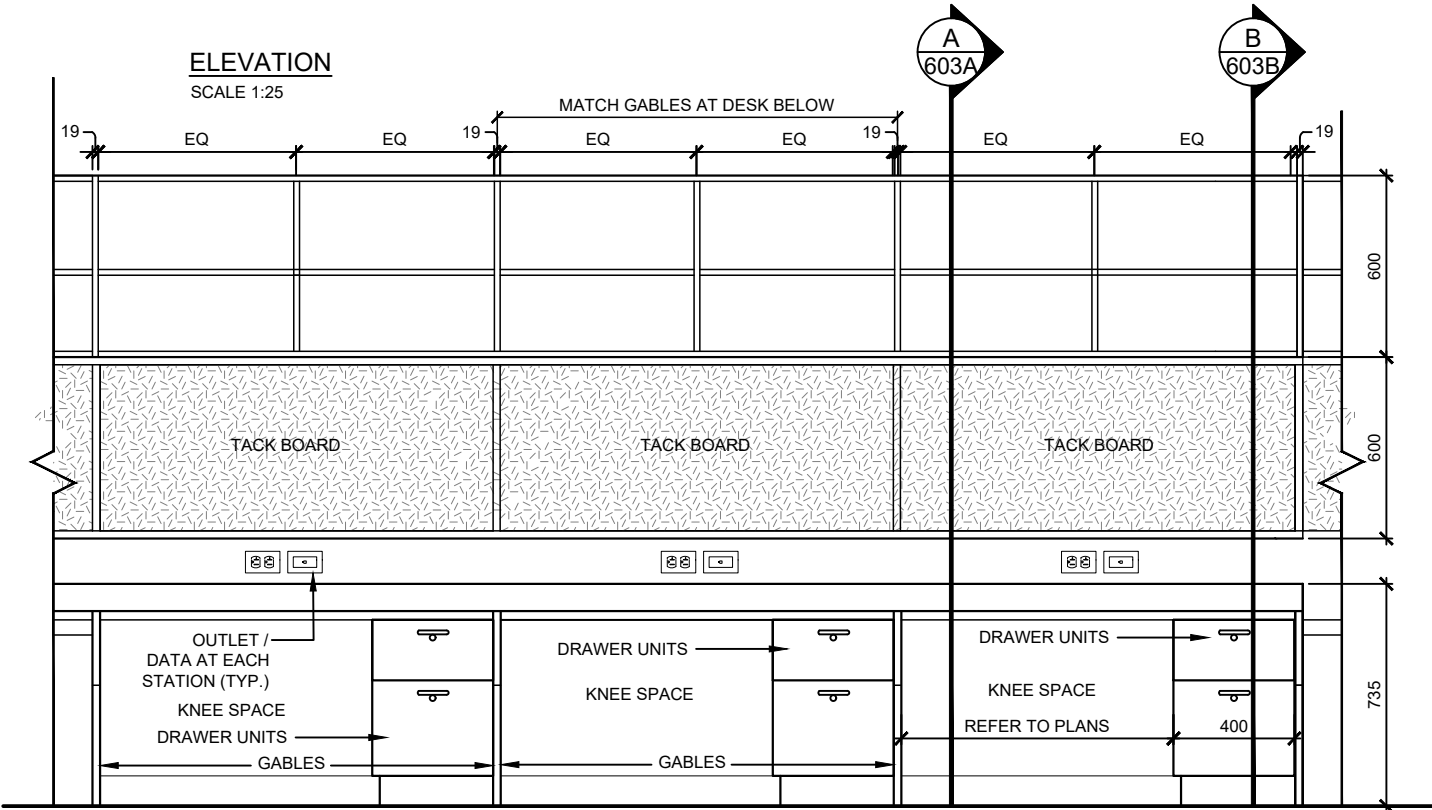
GRGURIC
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INCORPORATED
Web: www.2gai.com

AD
602B

NOTE: FULL LENGTH AND QUANTITY NOT SHOWN HERE
REFER TO FLOOR PLANS FOR TOTAL QUANTITY LENGTHS & CONFIGURATION
ADJUST SPACING TO SUIT



PLAN VIEW
SCALE 1:25



ELEVATION
SCALE 1:25

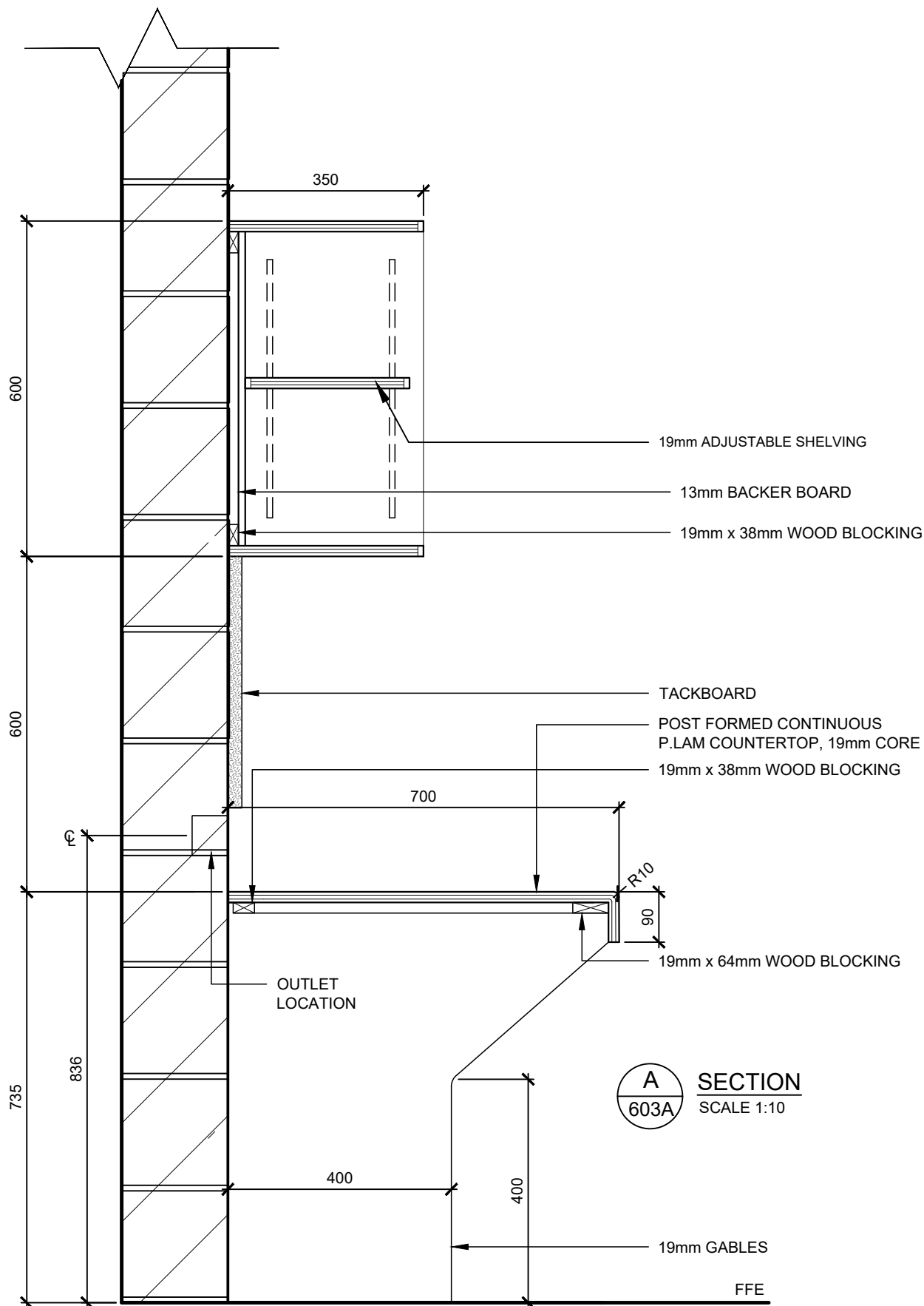
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ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.
MILLWORK TYPE MM1- WORKSTATION DESKS
(REFERENCE: A2.00, 2.10)

TYPICAL NOTE: MILLWORK IS 19mm CONSTRUCTION UNLESS OTHERWISE NOTED.
REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES

PROJ: 2025-06
SCALE: AS NOTED
DRAWN: R.P.
DATE: 2025-09-30

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**AD
603**



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.
MILLWORK TYPE MM1- SECTION DETAIL
(REFERENCE: A2.00, 2.10)

TYPICAL NOTE: MILLWORK IS 19mm CONSTRUCTION UNLESS OTHERWISE NOTED.
REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES

PROJ: 2025-06

SCALE: AS NOTED

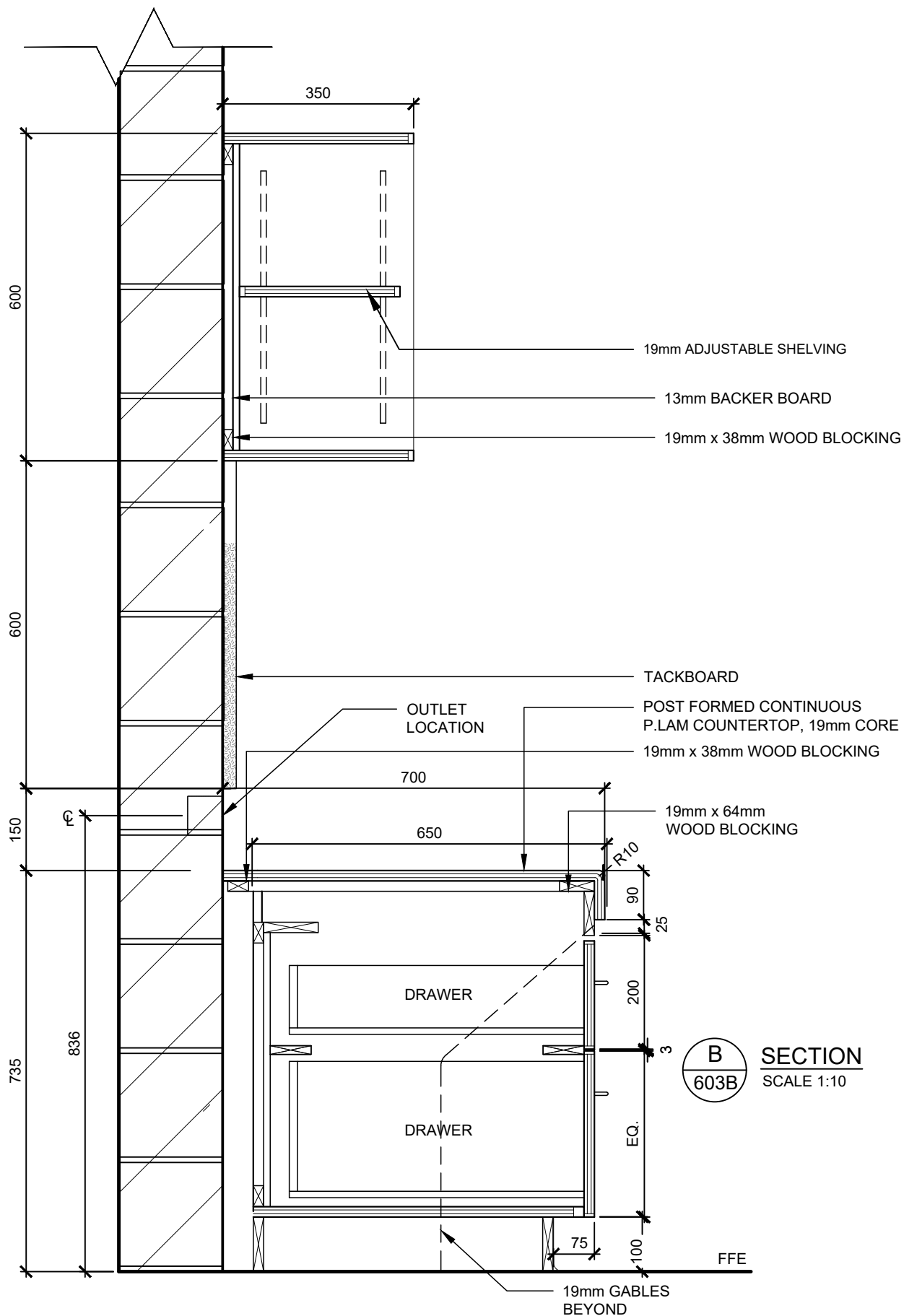
DRAWN: R.P.

DATE: 2025-09-30

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**AD
603A**



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
 504 CONNAUGHT STREET, KITCHENER, ON.
MILLWORK TYPE MM1- SECTION DETAIL
 (REFERENCE: A2.00, 2.10)

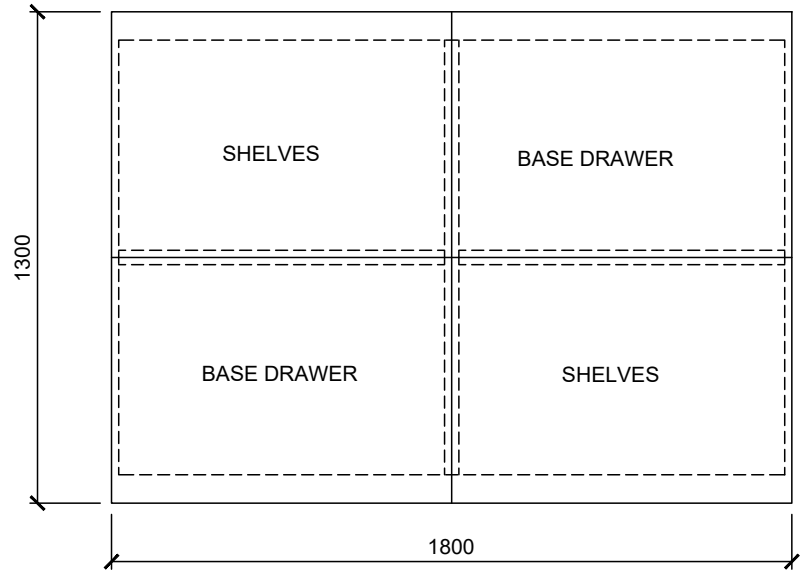
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 REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES

PROJ: 2025-06
 SCALE: AS NOTED
 DRAWN: R.P.
 DATE: 2025-09-30

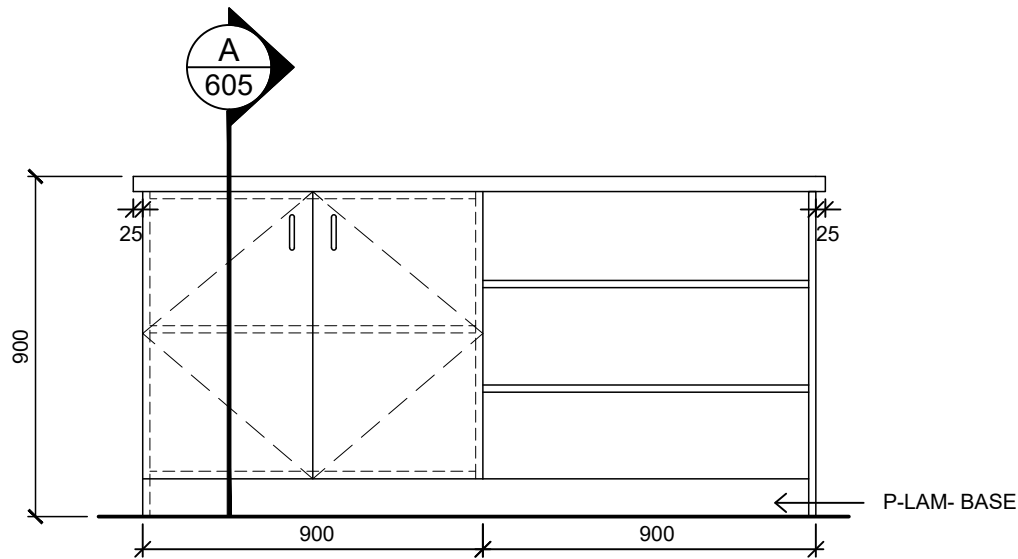
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**AD
 603B**

NOTE: REFER TO FLOOR PLANS FOR TOTAL QUANTITY LENGTHS & CONFIGURATION AND LOCATION



PLAN VIEW
SCALE 1:25



ELEVATION
SCALE 1:25

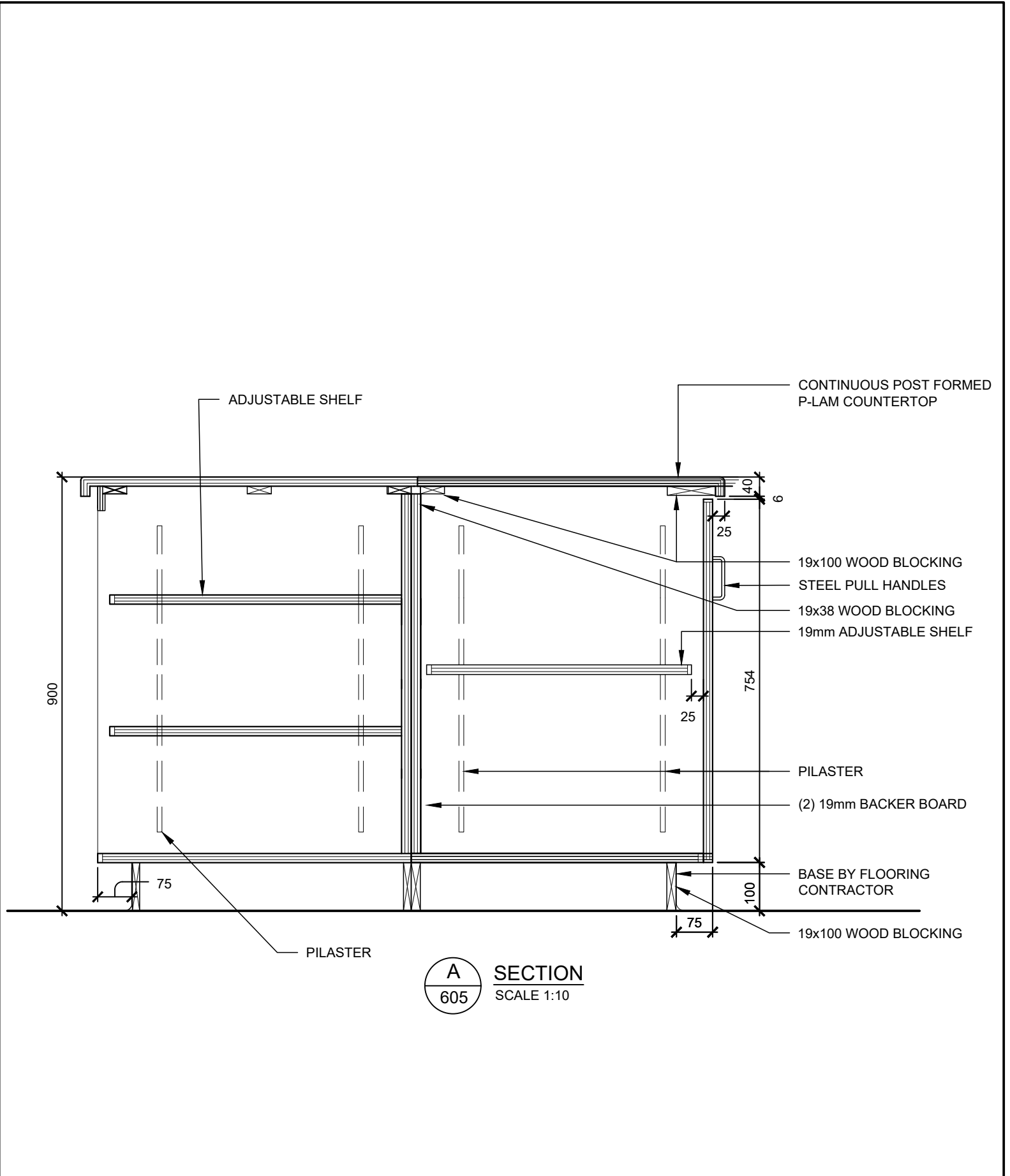
ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.
MILLWORK TYPE MM2- WORKSTATION ISLAND
(REFERENCE: A2.00, 2.10)

TYPICAL NOTE: MILLWORK IS 19mm CONSTRUCTION UNLESS OTHERWISE NOTED.
REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES

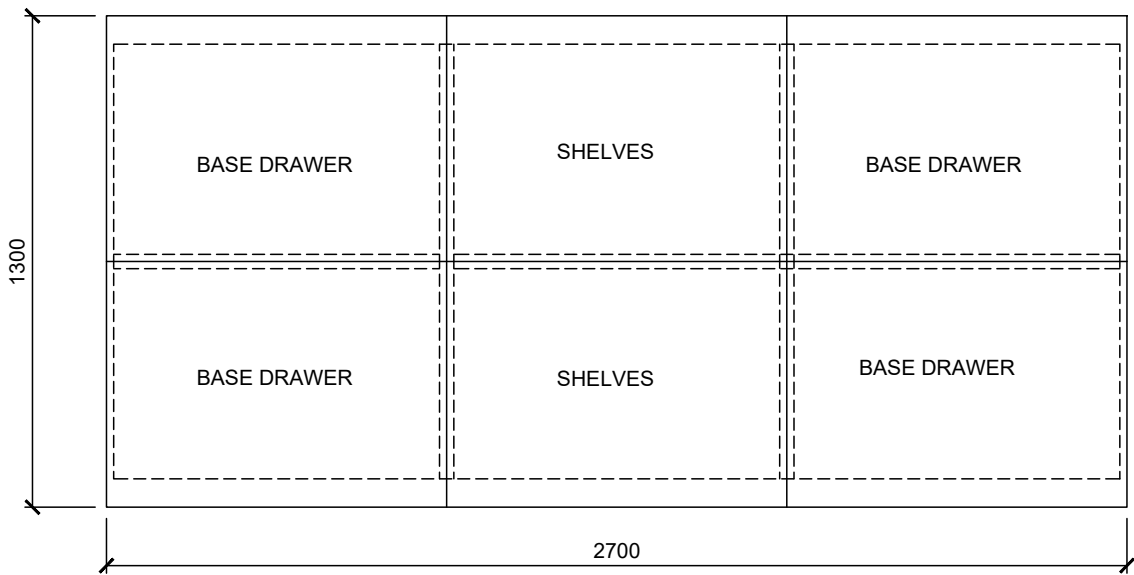
PROJ:	2025-06
SCALE:	AS NOTED
DRAWN:	R.P.
DATE:	2025-09-30

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Web: www.2gai.com

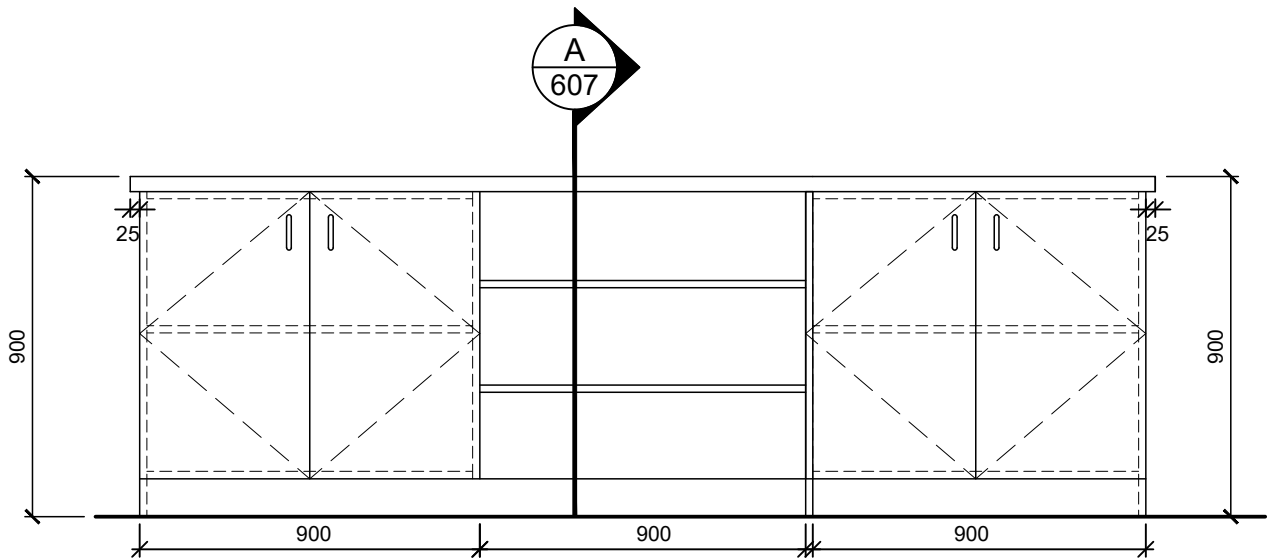
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604**



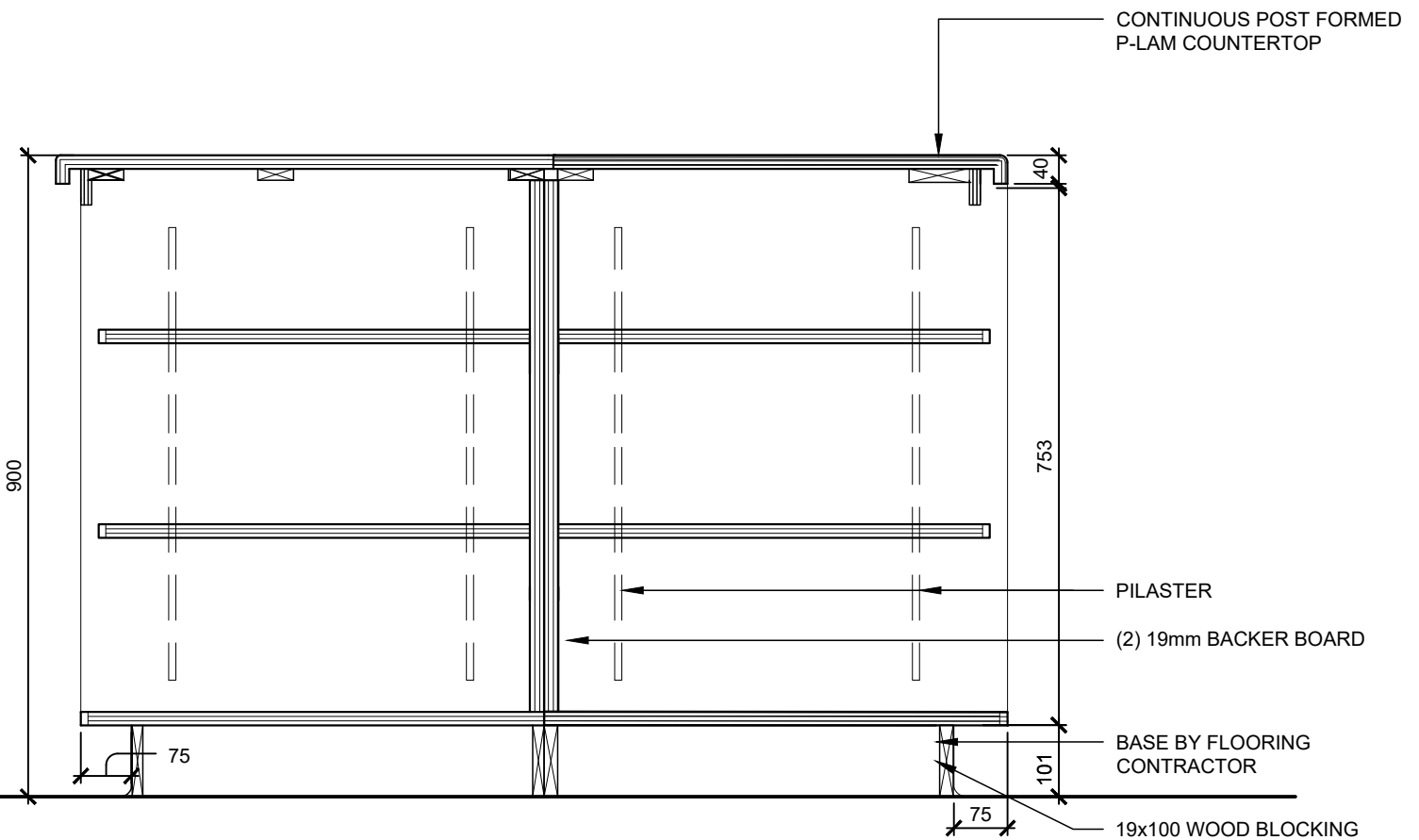
NOTE: REFER TO FLOOR PLANS FOR TOTAL QUANTITY LENGTHS & CONFIGURATION AND LOCATION



PLAN VIEW
SCALE 1:25



ELEVATION
SCALE 1:25



A
607

SECTION
SCALE 1:10

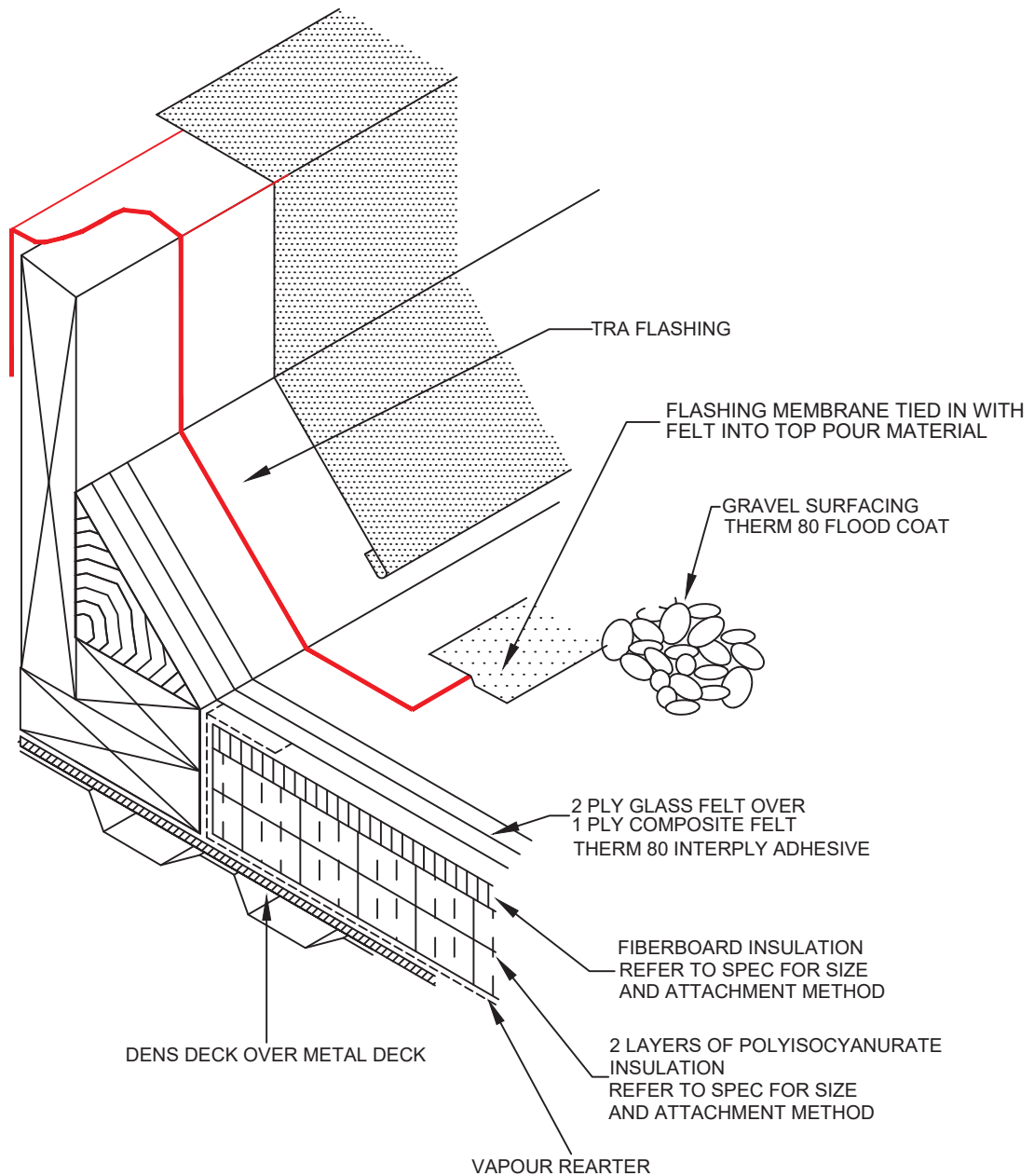
ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.
MILLWORK TYPE MM3- SECTION DETAIL
(REFERENCE: A2.00, 2.10)

TYPICAL NOTE: MILLWORK IS 19mm CONSTRUCTION UNLESS OTHERWISE NOTED.
REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES

PROJ: 2025-06
SCALE: AS NOTED
DRAWN: R.P.
DATE: 2025-09-30

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**AD
607**



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.

ROOF CURB DETAIL

PROJ: 2025-06

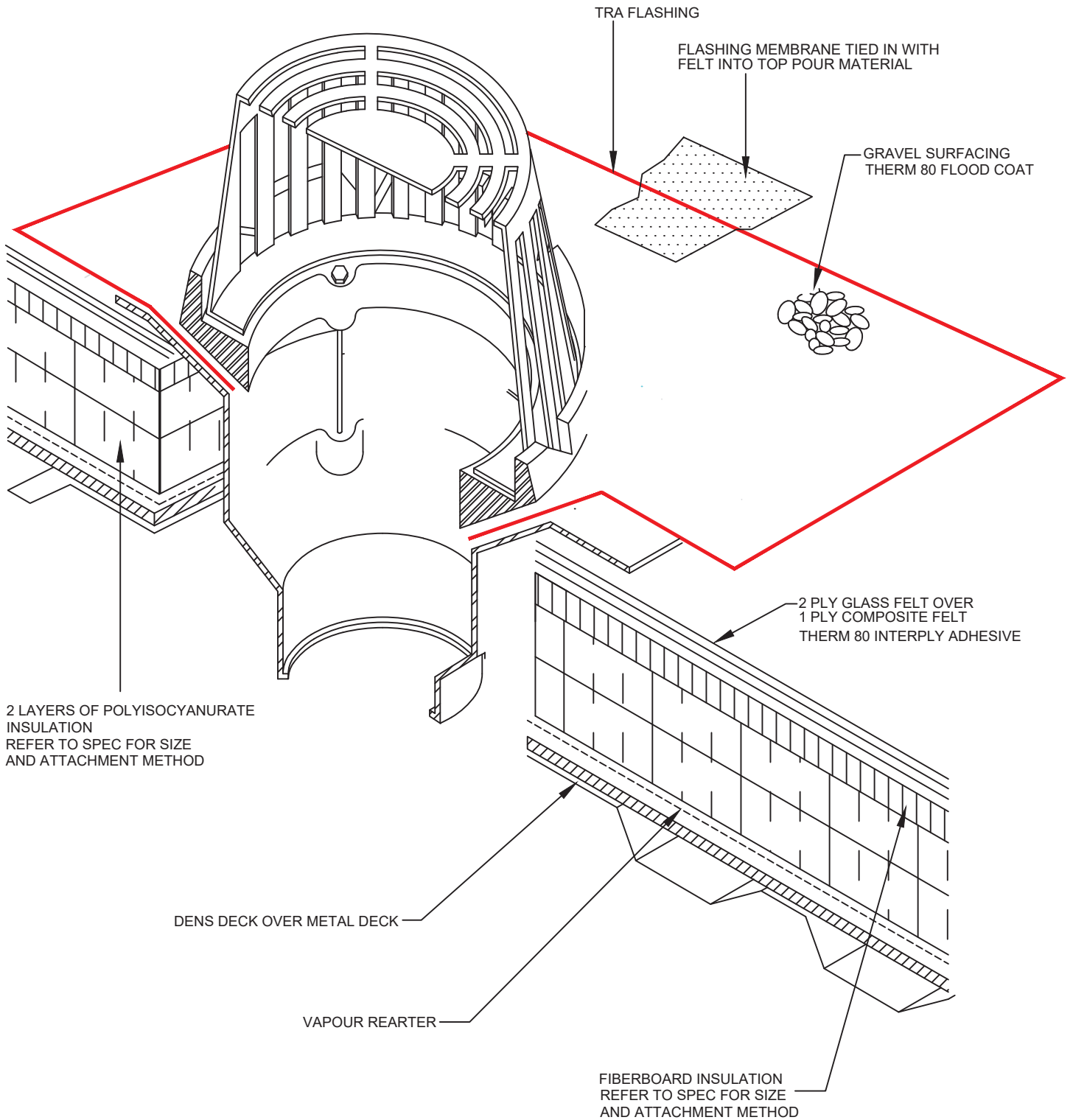
SCALE: AS NOTED

DRAWN: R.P.

DATE: 2026-02-23

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Web: www.2gai.com

**AD
700**



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.

ROOF DRAIN DETAIL

PROJ: 2025-06

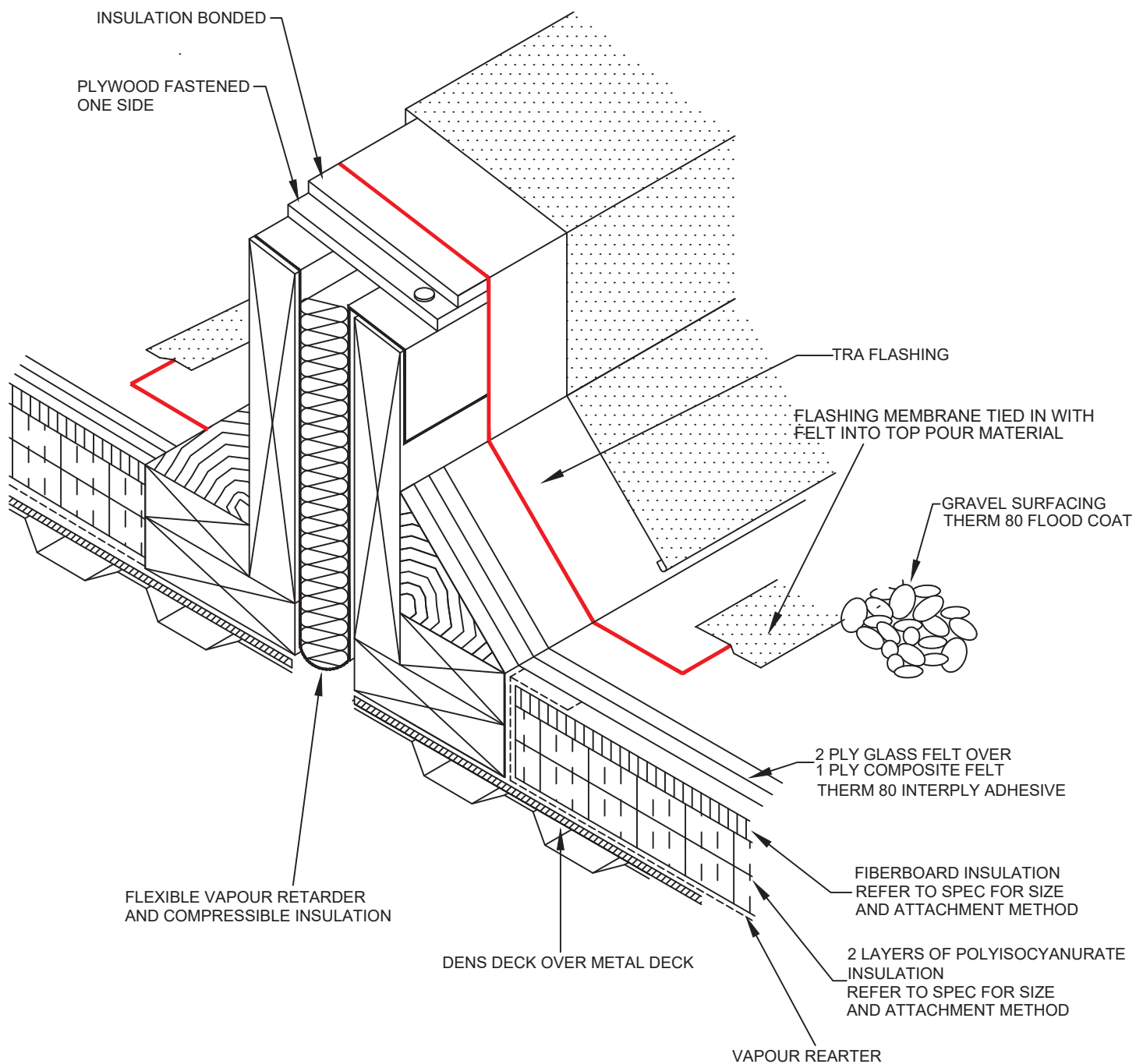
SCALE: AS NOTED

DRAWN: R.P.

DATE: 2026-02-23

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INCORPORATED**
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**AD
701**



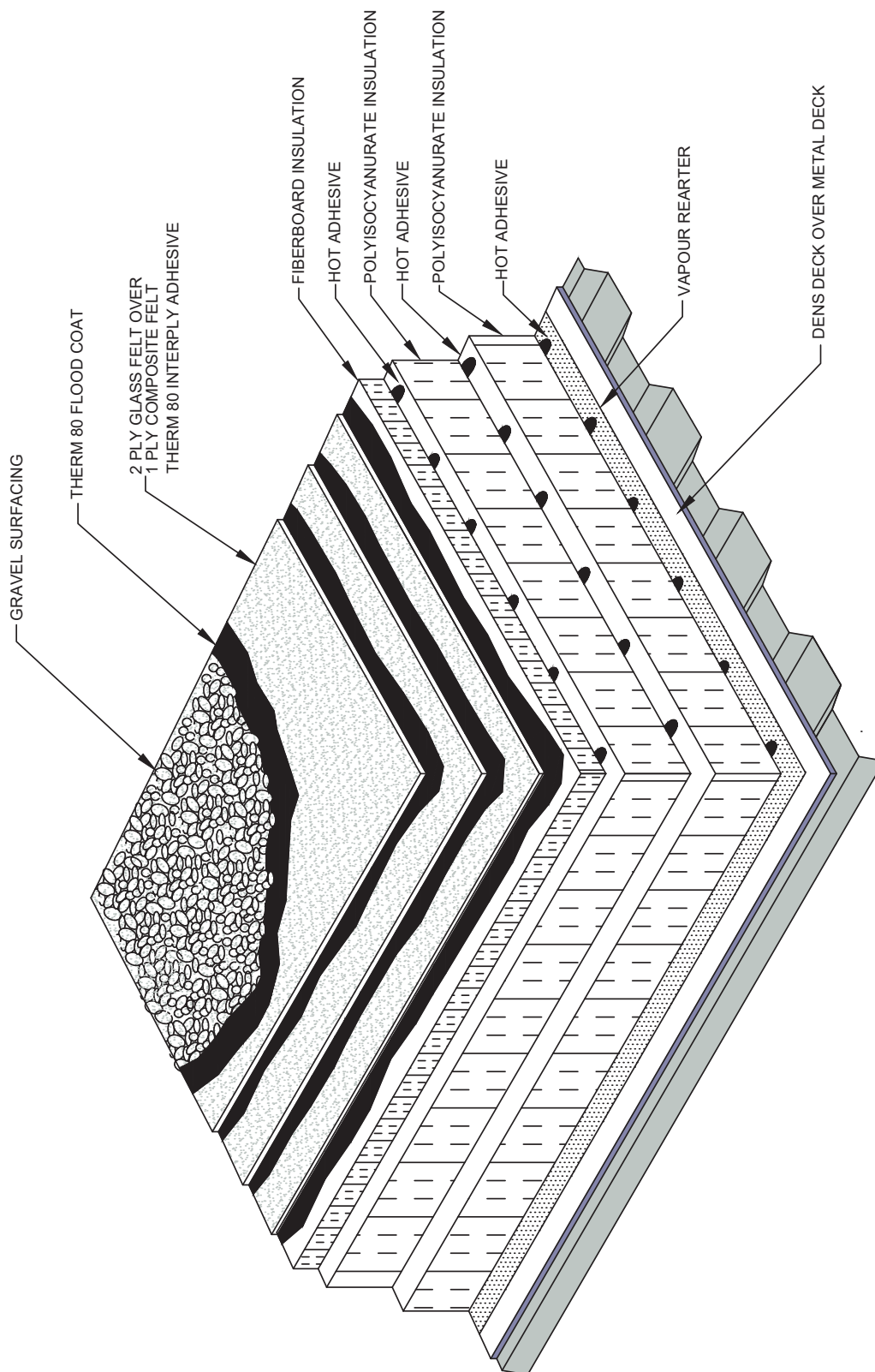
ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.

ROOF EXPANSION JOINT DETAIL

PROJ: 2025-06
SCALE: AS NOTED
DRAWN: R.P.
DATE: 2026-02-23

GRGURIC
ARCHITECTS
INCORPORATED
Web: www.2gai.com

AD
702



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.

ROOF CROSS SECTION ASSEMBLY

PROJ: 2025-06

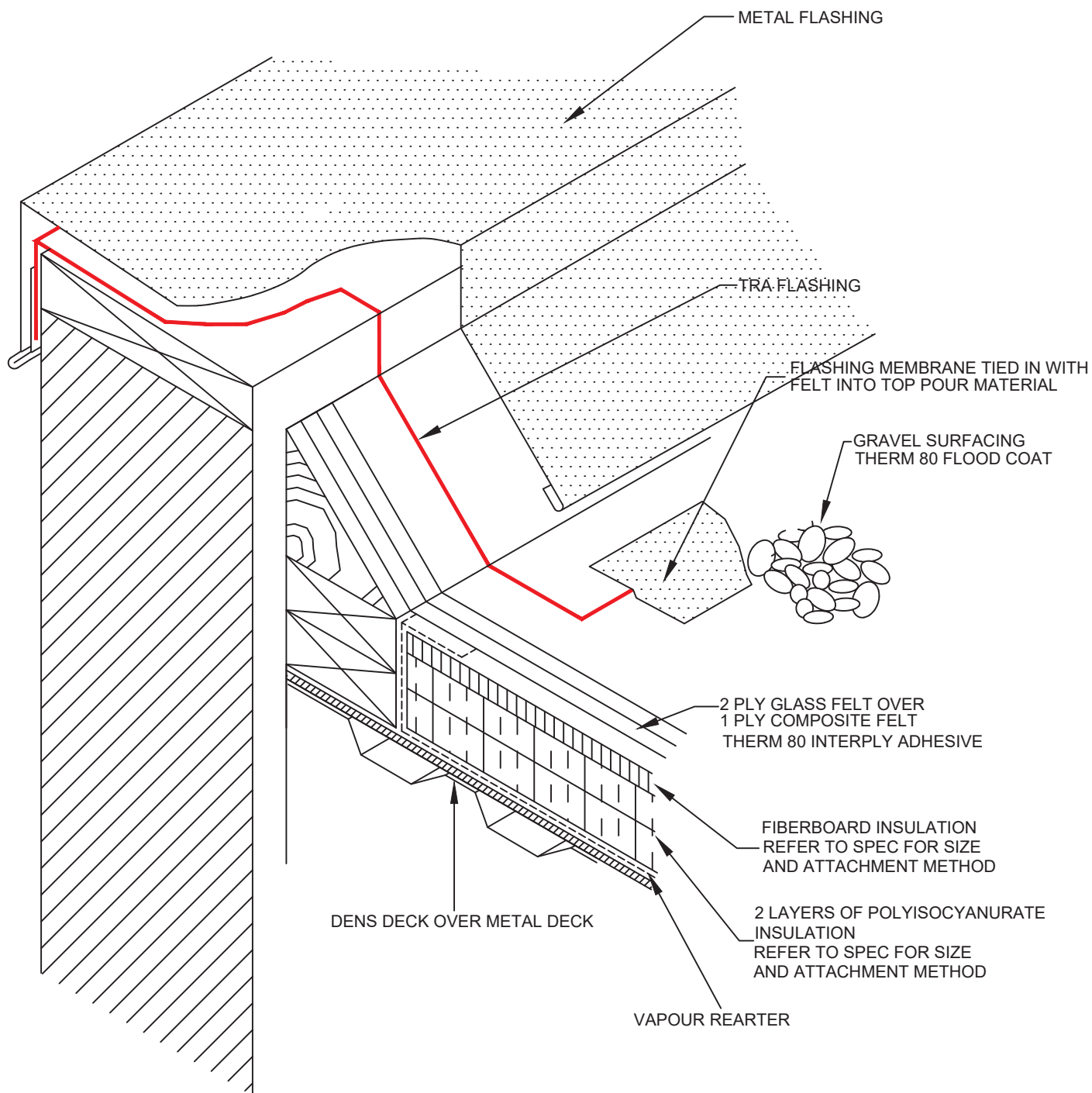
SCALE: AS NOTED

DRAWN: R.P.

DATE: 2026-02-23

**GRGURIC
ARCHITECTS
INCORPORATED**
Web: www.2gai.com

**AD
703**



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
 504 CONNAUGHT STREET, KITCHENER, ON.

LOW PAPAPET WALL DETAIL

PROJ: 2025-06

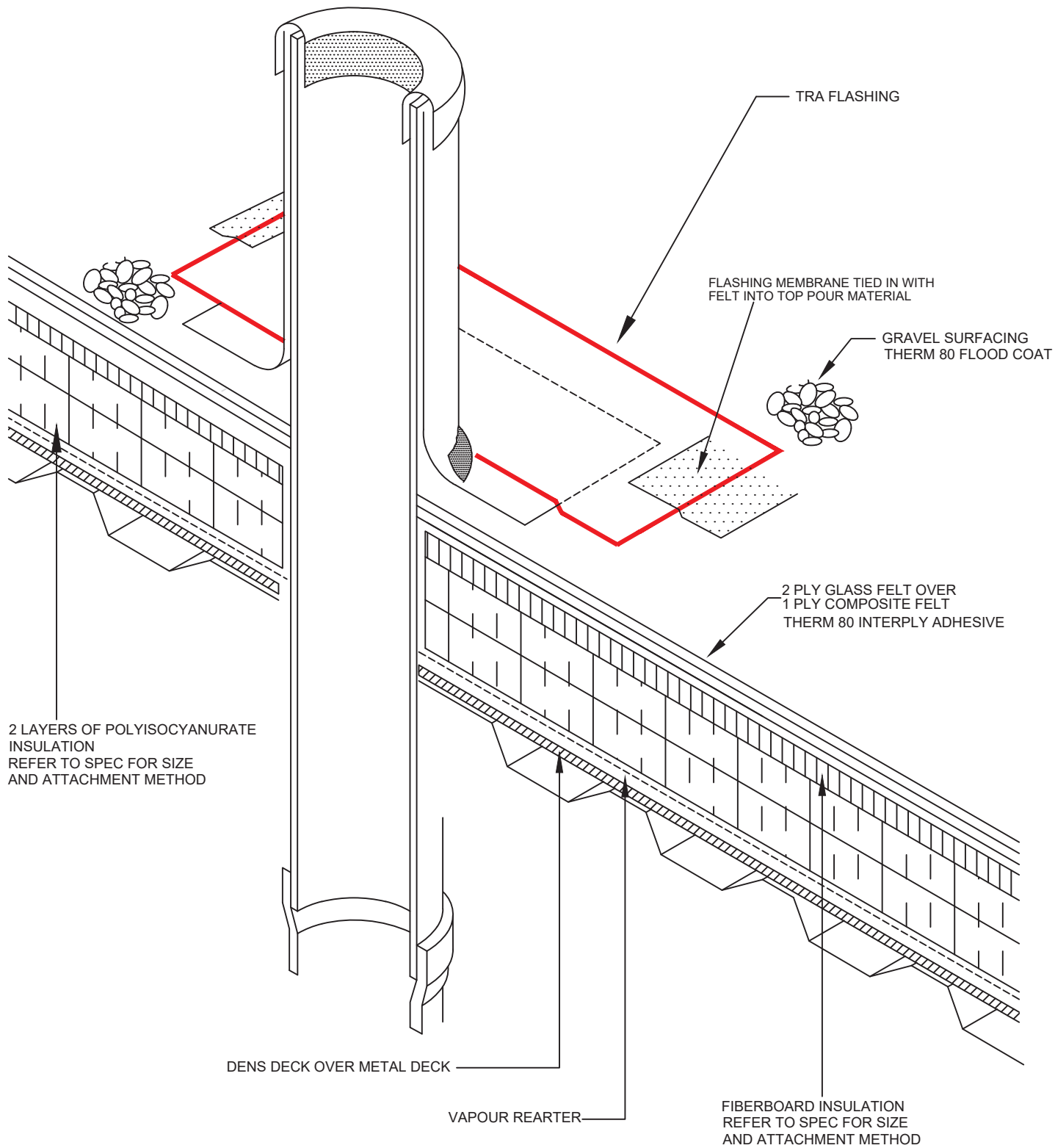
SCALE: AS NOTED

DRAWN: R.P.

DATE: 2026-02-23

**GRGURIC
 ARCHITECTS
 INCORPORATED**
 Web: www.2gai.com

**AD
 704**



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.

VENT WITH STACK JACK DETAIL

PROJ: 2025-06

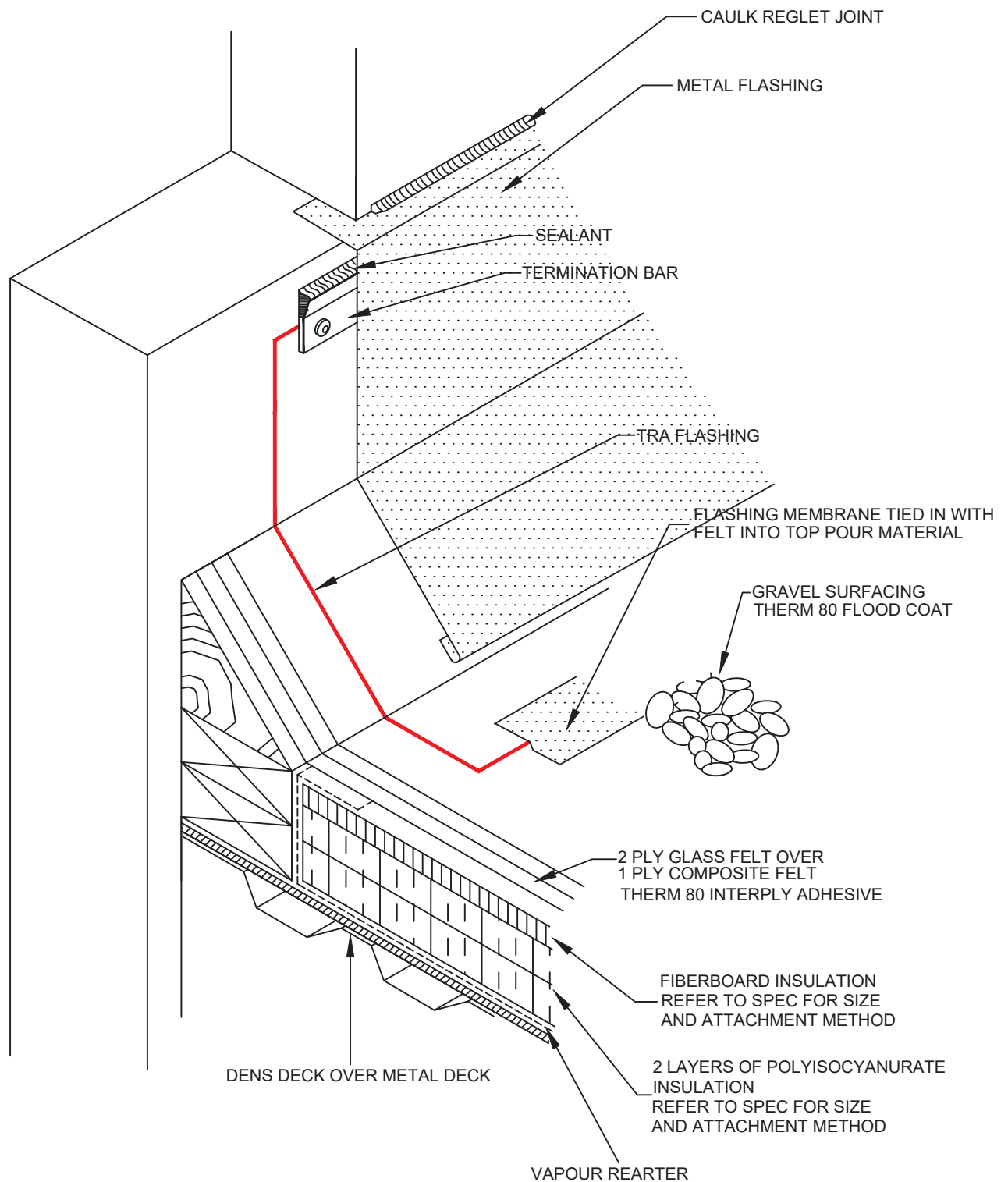
SCALE: AS NOTED

DRAWN: R.P.

DATE: 2026-02-23

**GRGURIC
ARCHITECTS
INCORPORATED**
Web: www.2gai.com

**AD
705**



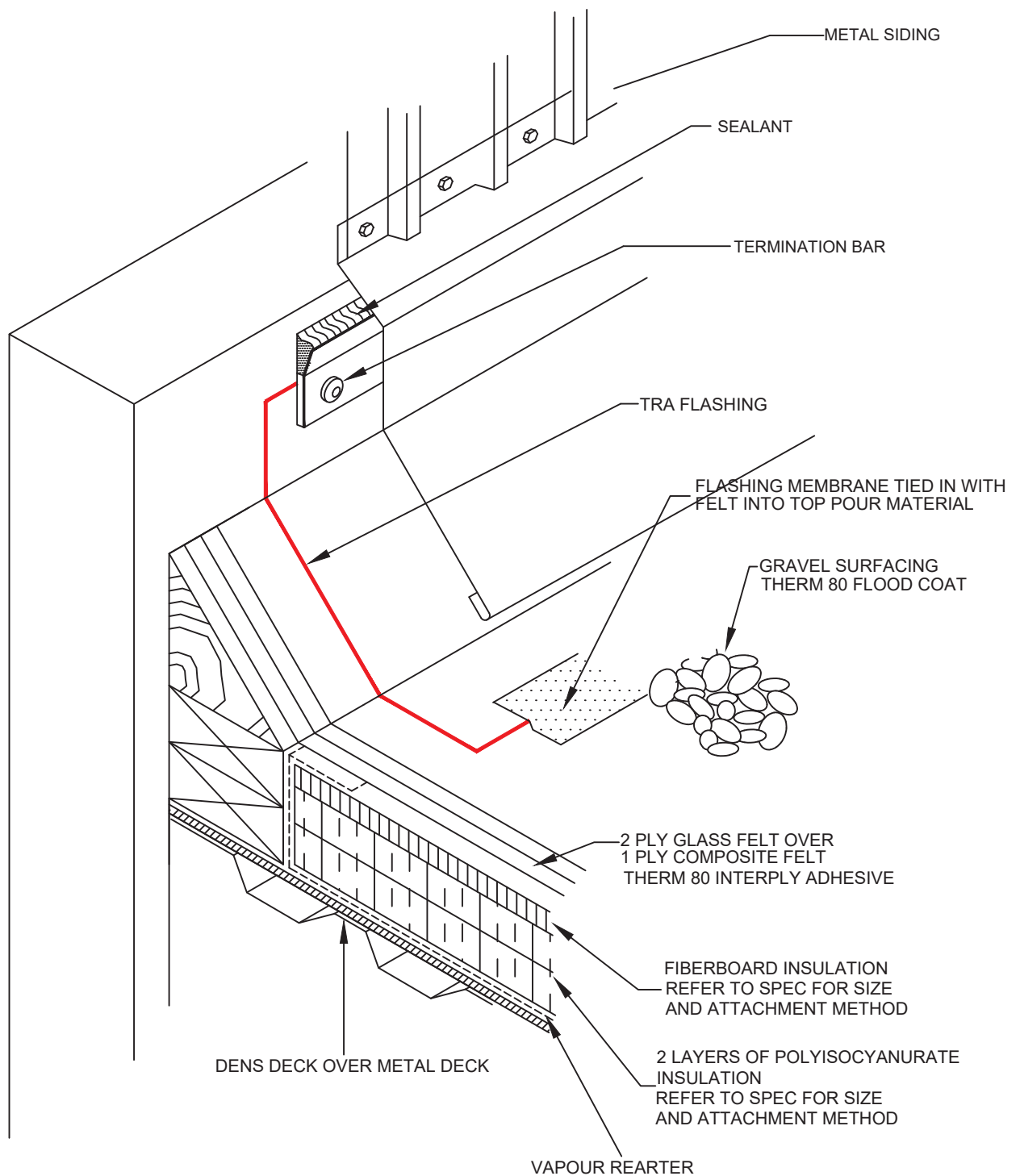
ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.

WALL FLASHING REGLET DETAIL

PROJ: 2025-06
SCALE: AS NOTED
DRAWN: R.P.
DATE: 2026-02-23

**GRGURIC
ARCHITECTS
INCORPORATED**
Web: www.2gai.com

**AD
706**



ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
 504 CONNAUGHT STREET, KITCHENER, ON.

WALL FLASHING WITH METAL CLADDING

PROJ: 2025-06

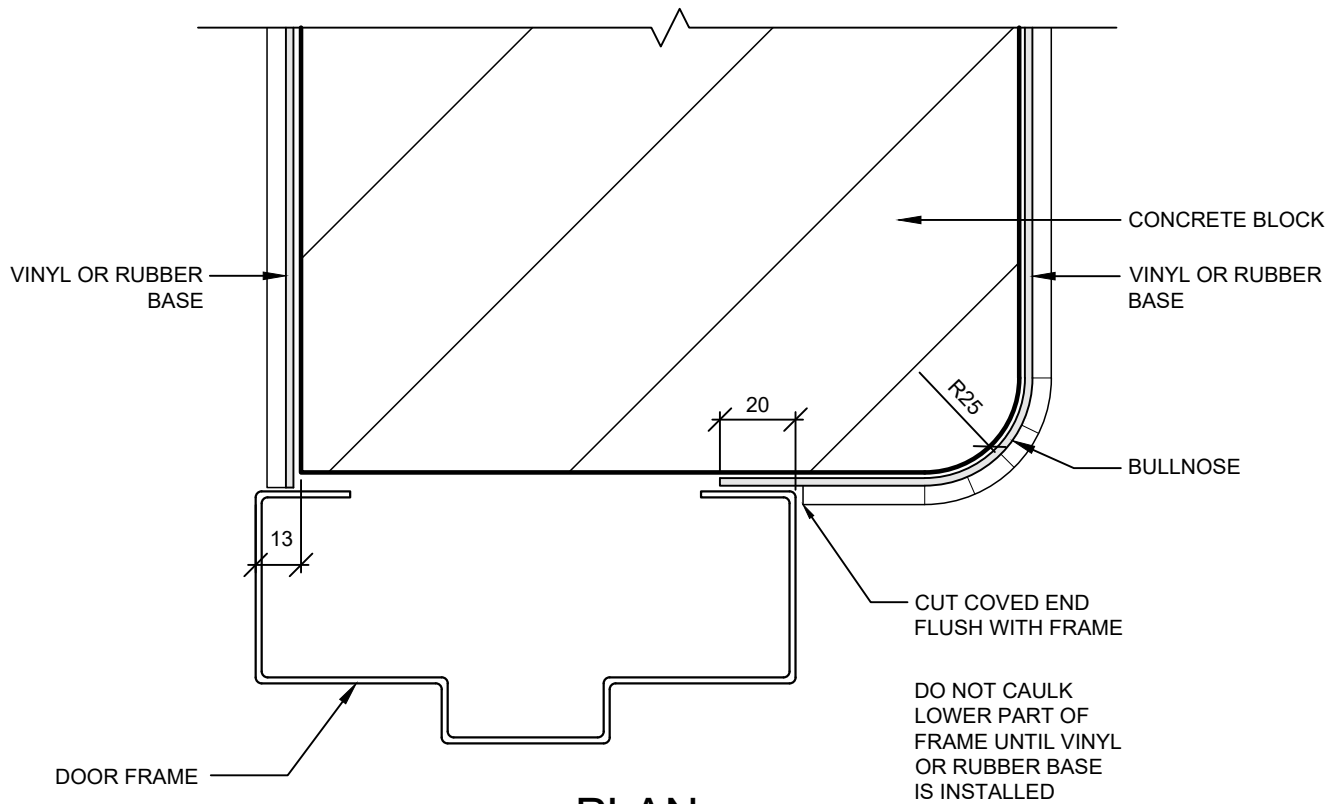
SCALE: AS NOTED

DRAWN: R.P.

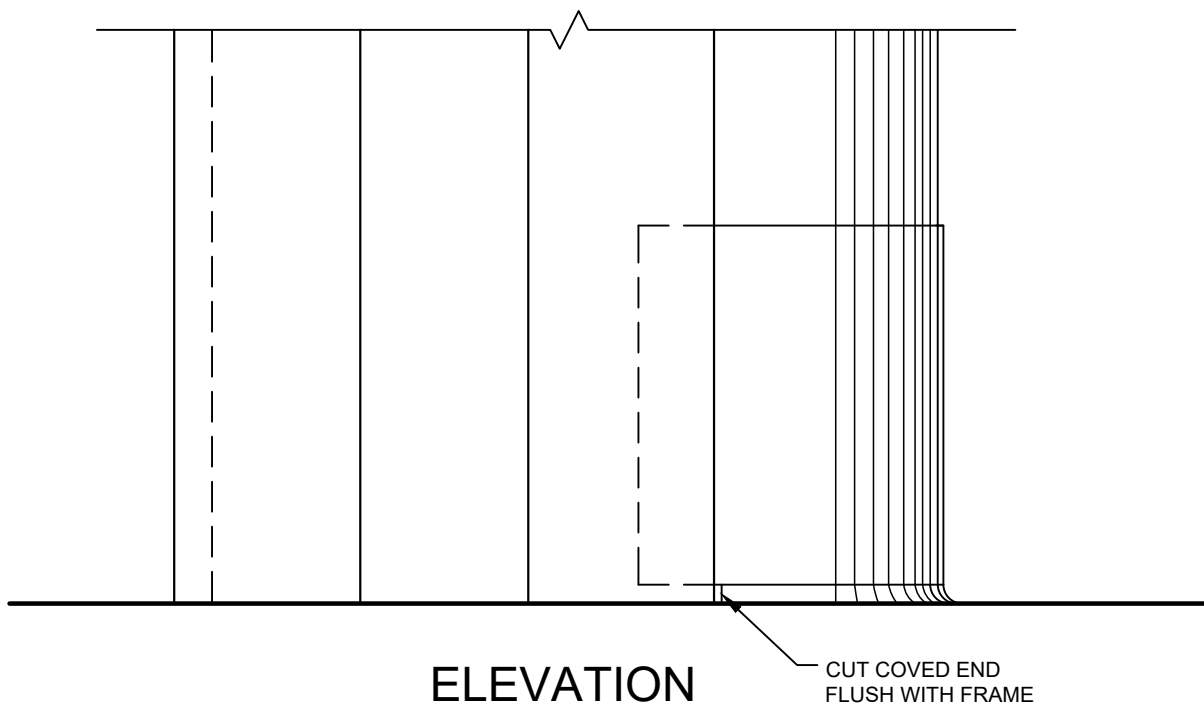
DATE: 2026-02-23

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 707**



PLAN



ELEVATION

ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
 504 CONNAUGHT STREET, KITCHENER, ON.

**VINYL / RUBBER BASE
 DETAIL**

PROJ: 2025-06

SCALE: AS NOTED

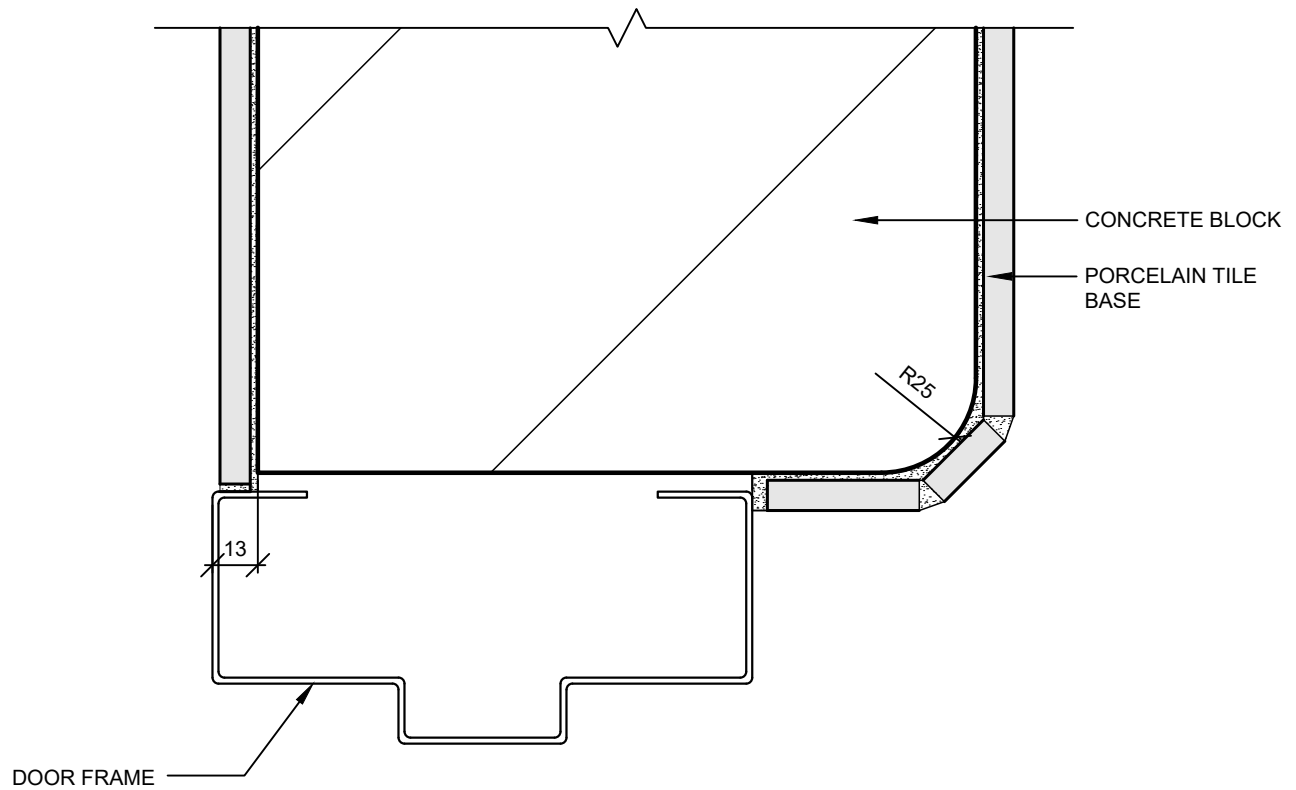
DRAWN: R.P.

DATE: 2025-09-30

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PLAN

TYPICAL DETAIL AT
BULLNOSE BLOCK

ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL:
ADDITION
504 CONNAUGHT STREET, KITCHENER, ON.

**PORCELAIN TILE BASE
DETAIL**

PROJ: 2025-06

SCALE: AS NOTED

DRAWN: R.P.

DATE: 2025-09-30

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Waterloo Catholic District School Board

Grguric Architects Inc.

Type of Document:

Mechanical Specifications Issued for Tender

EXP Project: ALL-25004500-A0, St. Aloysius
Catholic Elementary School - Addition,
504 Connaught St, Kitchener ON N2C 1C2

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2026-02-13



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504 CONNAUGHT ST, KITCHENER ON N2C 1C2
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<u>Drawing No.</u>	<u>Description</u>
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M1.01	MECHANICAL LEGEND AND ROOM INDEX
M2.00	UNDERGROUND PLUMBING PLAN
M2.01	GROUND FLOOR PLUMBING PLAN
M2.02	SECOND FLOOR PLUMBING PLAN
M3.00	GROUND FLOOR HVAC PLAN
M3.01	SECOND FLOOR HVAC PLAN
M3.02	ROOF HVAC PLAN
M4.00	GROUND FLOOR HYDRONIC PLAN
M4.01	SECOND FLOOR HYDRONIC PLAN
M5.00	GROUND FLOOR FIRE PROTECTION PLAN
M5.01	SECOND FLOOR FIRE PROTECTION PLAN
M6.00	PLUMBING SCHEMATIC
M6.01	BOILER SCHEMATIC
M6.02	SPRINKLER SCHEMATIC
M7.00	MECHANICAL DETAILS 1
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ME-1.0	MECHANICAL & ELECTRICAL SCHEDULES

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PART 1 - GENERAL

1.1 General Requirements

- .1 The Specifications of Section 15010 apply to and govern all Work of Division 15.
- .2 Comply with the Instructions to Bidders, the General Conditions of the Contract Documents and all amendments and supplements thereto, and with Division 1.
- .3 Include Ontario Harmonized Sales Tax as outlined in General Conditions and Tendering Instructions.
- .4 Whenever the word "Mechanical Consultant" is indicated in all Sections under Division 15 this to be defined as the "Mechanical Engineer" unless specifically indicated otherwise.

1.2 Scope of Specifications

- .1 The listing hereinafter of any article, material, operation or method requires that this Division is to Provide each item listed of the quality and subject to the qualifications noted, and this Division is to perform each operation prescribed according to the condition stated, providing therefore, all necessary labour, equipment and incidentals.

1.3 Related Work

- .1 It is the intent of these Specifications to supply and install all materials and equipment as hereinafter Specified and/or shown on the Drawings in such a manner as to leave each of the systems of the mechanical trades complete and in a satisfactory condition.

1.4 Definitions

- .1 Where used, words "Section" and "Division" shall also include other Sub-Contractors engaged on site to perform Work to make building and site complete in all respects.
- .2 Where used, word "supply" shall mean furnishing to site in location required or directed complete with accessory parts.
- .3 Where used, word "install" shall mean secured in place and connected up for operation as noted or directed.
- .4 Where used, word "Provide" shall mean supply and install as each is described above.
- .5 Where used, words "municipality" or "authorities" shall mean agencies that enforce applicable laws, ordinances, rules, regulations or code of the Place of the Work.
- .6 Where used, the word "Consultant" shall mean the Project Prime Consultant (Architect).
- .7 Where used, word "Work" shall mean all equipment, permits, materials and labour to Provide a complete mechanical installation as required and detailed in the Drawings and Specifications.
- .8 Where the words "Drawing" and "Specifications" are referred to, it means the "Contract Documents".
- .9 Where used, words "Prime Mechanical Contractor" shall mean supervisory Mechanical Contractor of all Mechanical sub-Contractors.

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- .10 The terms "instructions" or "as instructed" or "where instructed" mean as instructed by the Consultant, including Supplemental Instruction notices; job site instruction notices; job site instructions by a field representative/ inspector appointed by the Consultant and including all comments made regarding submittal of Shop Drawings and samples for review.
- .11 The term "exposed" means within the line of sight of any person standing or sitting in the occupied space, unless defined otherwise in the following sections.
- .12 The term "concealed" means not exposed.
- .13 The term "listed" means that the materials or equipment are tested in accordance with applicable standards, and are approved and listed for their intended use by a testing company approved by the Authorities having jurisdiction.
- .14 The term "approved", "approvals", means approved by Authorities having jurisdiction as conforming to the requirements of the Contract Documents.
- .15 The term "acceptable" or "acceptance", means acceptable to the Consultant as conforming to the requirements of the Contract Documents.
- .16 The term "submit for review" or "submit notice", means submit to the Consultant.
- .17 The term "subject to review" means Work or materials laid out for review by the Consultant. Obtain instruction from the Consultant before proceeding with the Work. Submit further information, Shop Drawings, samples, as specified and/or as may be reasonably requested by the Consultant.
- .18 The term "accessible" used alone means readily accessible by a person using tools as required without cutting or breaking out materials.
- .19 The term "noted" means noted on the Drawings, the Detail Drawings and on the Schedules.

1.5 Scope of Work

- .1 Related Work Specified Elsewhere
 - .1 Electrical Division 16
- .2 This Division is to include the supply of all labour, tools, equipment and materials for the installing, testing and putting into proper operation the complete system as herein specified, as shown on the Drawings, or as is reasonably inferable from either or both.
- .3 Equipment items that are supplied as packaged units under this Division are to include all internal wiring, relays, contactors, switches, transformers, motor starters, controls and ancillaries as required for the intended operation, and to be complete with all necessary terminals suitable for connection to power source, and external devices at a single location.

1.6 Intent of Specifications & Drawings

- .1 Any specific item or Work omitted from one and which is mentioned or reasonably implied in the other is to be considered as properly and sufficiently specified and must be provided by this Division.

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- .2 Should any discrepancy or conflict appear between these Specifications and the Drawings which leave this Division in doubt as to the true meaning and intent of the Drawings and Specifications, a ruling is to be obtained from the Consultant **BEFORE SUBMITTING THE TENDER**. If clarification is not sought prior to the closing of tender, the Consultant's decisions are final, conclusive and binding on this Division.

1.7 Regulation & Permits

- .1 All Work to be carried out in accordance with the latest editions of all relevant authorities, codes, or regulations including but not limited to Ontario Building Code (OBC), including Part 7, Plumbing; Canadian Regulations for the Construction and Inspection of Pressure Vessels; Ontario Fire Code (OFC); Ministry of Labour Guidelines; Occupational Health and Safety Act; Ontario Electrical Safety Code; Gas Utilization Code; Canadian Heating, Ventilating and Air Conditioning Code; National Fire Protection Association (NFPA); Canadian Standards Association (CSA); and American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) Standards.
- .2 All authorized code inspections required by above mentioned laws, rules and regulations, inclusive of any fees, obtaining of permits, issuance of notices are to be arranged and paid for by this Division.
- .3 Furnish all necessary certificates as evidence that Work installed complied with aforementioned laws and regulations of all governing authorities, prior to acceptance of the Work and before the final certificate of payment is issued.
- .4 Any deviations from the plans or Specifications requested by an official representing one or any of the authorities having jurisdiction over that portion of the Work must be brought to the attention of the Consultant prior to proceeding with the change. Any additional costs incurred for extra Work performed without instruction from the Consultant will not be considered.

1.8 Examination of Site & Documents

- .1 This Division and related sub-trades, before tendering, are to examine the site and all Drawings and Specifications of other trades and familiarize himself with local conditions, building construction and finishes affecting the Work under this section. No allowances are to be made for any extra expense incurred by him through his failure to do so.

1.9 Contract Drawings

- .1 The Contract Drawings are not intended to be Shop or Working Drawings and all measurements are to be taken from the Architectural dimensioned Drawings or in the field. This Division shall make, without any extra expense or credit to the Owner, any necessary changes or additions to the Work to accommodate the Architectural or Structural conditions.
- .2 Where Shop or Working Drawings are required, this Division shall provide them and submit them to the Consultant for review.
- .3 The Contract Drawings show the minimum standard acceptable regardless of any lesser standards set by any codes or regulations having jurisdiction.
- .4 The Architectural, Structural and Electrical Contract Drawings are to be examined to ensure that the Work of this Division may be satisfactorily completed.
- .5 Notify the Consultant upon discovery of any conditions, which adversely affect the Work of this Division. No allowances are to be made after awarding Contract for any expenses incurred through failure to do so.

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- .6 The Drawings upon which this Contract is based show the arrangement, general design and extent of the piping, ductwork and other systems. These systems are suitably outlined on the Drawings with regard to size, location, general arrangement and installation details. The mains and connections thereto are shown more or less in diagram, except where in certain cases, the Drawing may include details giving the exact locations and arrangements required. All piping and ductwork shall be concealed unless shown otherwise.
- .7 Where any parts of the system and/or pieces of equipment are located by dimensions of the Drawings, said dimensions shall be checked and verified in the field. Each Division shall make, without additional charge or expense to the Owner, any necessary changes, additions or offsets to the runs to accommodate structural conditions. The Consultant shall be modified immediately and his authority secured in writing for such revisions before proceeding with the Work.

1.10 Storage & Protection of Materials

- .1 Proper facilities for storage and protection of material and equipment are to be provided at the job site by this Division.
- .2 All pipe to be used on the job to be carefully stacked off the floor with ends capped or suitably plugged to prevent the entry of dirt and debris until such time the piping is being installed. Similarly all openings in pressure vessels, tanks, etc., to be kept closed until ready for use. Any piping not suitably protected to be removed from the site and replaced with new.
- .3 Equipment located on site must also be suitably protected to prevent damage from abuse or misuse. Protect all bearings and motors from damage due to moisture and dust. Equipment not yet in operation shall be turned over at least monthly to prevent bearing deterioration. Equipment and/or materials damaged after delivery to site is to be replaced or repaired to the satisfaction of the Consultant.
- .4 Make known any hazardous or flammable materials to be used and method of application, before using. This Division shall be responsible for proper storage and all necessary safety requirements in the storage and use of all hazardous and flammable materials used in the execution of their Work.

1.11 Delivery

- .1 Transport and handle the material in conformance with the Manufacturers instructions.
- .2 Deliver the materials to the job site in their original packaging. The name and address of the manufacturer must be labelled on the packaging.
- .3 Packing Waste Management:
 - .1 Recover the packaging waste so that it may be reused, recycled or reclaimed by the Manufacturer. This includes, but is not limited to, pallets, packing, and other packing material.

1.12 Co-Operation of Trades

- .1 The Prime Mechanical Contractor is to 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 trade. Any reworking of installed equipment, piping, or ducting to accommodate the installation of other trades Work shall be performed at no extra cost.

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1.13 Warranty

- .1 The Prime Mechanical Contractor to Warrant Products and execution of Work under this Division against defects of material and workmanship for one (1) full year after date of Substantial Performance.
- .2 Repair defects that are discovered or develop during this period and make good any resulting damage to equipment or building. Repairs to be carried out at no cost to Owner.
- .3 Provide extended warranties where indicated in other sections of this Division. Extended warranties to commence on termination of the standard one year warranty and to be an extension of these same provisions.

1.14 Charges for Extras & Credits

- .1 Extras and credits for Division 15 Contractors and Sub-Contractors shall be charged on the following basis:
 - .1 Materials - trade price¹ plus overhead plus profit as outlined in the General Conditions.
 - .2 Labour - Journeyman's and foreman's labour at current local union rates plus worker's compensation plus unemployment insurance plus overhead plus profit as outlined in the General Conditions.
 - .3 Labour hour charges shall be within 10% of the unit prices in the National Labour Calculator.
- .2 Credits shall be the same as above, except no overhead and profit.
- .3 Disputes shall be settled by arbitration.
- .4 All submittals must include a detailed breakdown showing lengths, sizes, quantities of materials, unit labour charges with labour rates, mark ups, overhead and profits with totals. Submittals that do not include a detailed breakdown cannot be reviewed.

1.15 Local Utilities

- .1 The Prime Mechanical Contractor, before tendering, to contact all utilities to determine the local procedures and policies concerning services, and portions of that service which would be supplied or available through the utilities and incur any cost. The Prime Mechanical Contractor to ensure no delays in construction or service connections.

1.16 Existing Services

- .1 Where Work involves breaking into or connecting existing services, carry out Work at times directed by governing authorities, with minimum of disturbance to the premises and its operation.
- .2 Before commencing Work, establish location and extent of service lines in area of Work and notify Consultant of finding.
- .3 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.
- .4 Remove abandoned service lines. Cap or otherwise seal lines at cut-off points, in manner approved by authorities having jurisdiction over service.

¹ Trade price means the price at which the Contractor or his Sub-Contractor pays for the materials including all discounts.

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- .5 Record locations of maintained, re-routed and abandoned service lines. The sub-Contractors concerned shall provide this Division with all necessary dimensions required to accurately locate those services.
- .6 Where the location of any of these utilities has been shown on the plans, such information is not guaranteed. It is the responsibility of this Division to verify locations and elevations, immediately after they move on the site. If for any reason the information obtained necessitates changes in procedures or design, they must advise the Consultant at once. If this verification of existing conditions is not done at the outset and any problems arise, the responsibility for same is entirely this Contractor's.
- .7 Where it is necessary to temporarily shut down equipment or services serving essential areas, this Division shall include premium costs to ensure the Work force is scheduled for "round the clock" operation in order to minimize disruption and equipment downtime.

1.17 Interference Sketches

- .1 Before shop fabrication begins or undertaking installation Work inside the building, prepare an integrated set of mechanical interference sketches, where indicated on the Drawings.
- .2 These sketches shall be prepared by Prime Mechanical Contractor with the co-operation of other trades and shall show the location or space allocated for the Work of each trade.
- .3 Submit two (2) copies of detailed interference sketches showing structural members, electrical conduits, devices and all mechanical elements to the Consultant for review and general approval before proceeding with the Work.
- .4 Copies of these reviewed interference sketches shall be submitted to all trades, the General Contractor, the Architect, and the Consultant, and general approval shall be obtained before the space allotment.
- .5 As a minimum, interference sketches shall be made for all areas of mechanical equipment rooms and corridor ceiling spaces.
- .6 Work that has been installed before review of interference sketches and has been determined that it is in conflict with the building shall be removed from the site at no extra cost to the Owner. The Work, reviewed by the Consultant, shall be installed at no extra cost to the Owner.

1.18 Record Drawings

- .1 This Division will provide an extra set of whiteprints to be marked up by this Division, in red ink, as the job progresses, showing all changes and deviations from the plans, so that on completion of the job, the Consultant will have a record of the exact location of all piping, ductwork and equipment. These Drawings shall be available during construction at all times and will be reviewed monthly by the Consultant. Submit updated Mechanical Drawings in AutoCAD format to the Consultant with the Maintenance Manuals.
- .2 Electronic AutoCAD files will be made available to the Prime Mechanical Contractor for this purpose. Contractor will be required to complete the release form "Transfer of Electronic Media" in order to receive the files. See below.
- .3 Record Drawings shall locate all concealed shut-off valves, dampers, control valves, coils and concealed air vents.

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- .4 Before Substantial Completion of the Project, the Contractor shall provide and electronic copy of all updated Record Drawing information, as specified herein.
- .5 Record location of concealed mechanical services and components. Dimension and reference all concealed and buried mechanical services from visible and accessible permanent features of structure.

1.19 Liability

- .1 Each Section and Trade shall:
 - .1 Assume full responsibility for laying out his Work and for any damage caused to other Sections or Owner by improper location or carrying out of same.
 - .2 Be responsible for prompt installation of Work in advance of concrete pouring, ceiling installation or similar Work.
 - .3 Protect finished and unfinished Work of this Division and Work of other Sections from damage due to Work of this Division.
 - .4 Be responsible for condition of material and equipment supplied. Be responsible for protection and maintenance of Work completed until termination and acceptance.

1.20 Permits & Fees

- .1 Pay all permit and inspection fees as required to complete the Work of Division 15.

1.21 Maintenance & Maintenance Manuals

- .1 Refer to Section 15011 - Submittals.

1.22 Electrical Wiring & Wiring Diagrams

- .1 All motors for equipment under this Division will be by this Division. All starters, switches and power wiring will be provided by Division 16, except where noted. Where electrical requirements for equipment exceeds the provisions described in the Electrical Specifications, this Contractor shall provide labour and materials as required to complete with installation. All motors, switches and equipment shall be of Canadian manufacture: Westinghouse Canada, Canadian General Electric, Allen-Bradley, Square 'D', Robins & Meyers, Lincoln, Tamper.
- .2 Provide with shop drawings, a comprehensive wiring diagram for all mechanical equipment requiring review. Shop drawings will not be reviewed unless accompanied by the wiring diagrams.

1.23 Protection

- .1 Protect work from damage. Securely plug or cap open ends of conduits, pipes, ducts or equipment to prevent entry of dirt, dust, debris, water, snow or ice. Clean all piping, ducting, conduits and equipment inside and outside before testing.

1.24 Co-Ordination

- .1 The Prime Mechanical Contractor is responsible for co-ordinating the mechanical Work herein to suit Project Phasing Schedule.
- .2 Co-ordinate all Mechanical Work with the Work of any other Divisions to avoid conflicts. Be responsible for modifying the Work of this Division to accommodate space conflicts.

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- .3 Failure to coordinate will result in installed Work being removed and new Work put in place at no cost to the Owner.
- .4 Refer to Architectural Specification for Project phasing plans and description.

1.25 Fire Stopping

- .1 The Prime Mechanical Contractor is responsible for all fire stopping related to the Work of Division 15 including, but not limited to, the ductwork, piping and control wiring. Fire Stopping shall be in accordance with the Architectural Specifications.

1.26 Impeller, Sheave & Belt Changes

- .1 The Prime Mechanical Contractor to carry the costs to supply and install pump impellor, fan sheave and belt changes. See Section 15013 - Systems Balancing.

1.27 Alternate Prices

- .1 Refer to the Tender Form for requested mechanical alternate price information.

PART 2 - PRODUCTS

2.1 Materials

- .1 Materials and equipment are specifically named and described in this Specification to establish a standard that this Division is to adhere to.
- .2 The term "**Acceptable Product**" is used to indicate a Product or Manufacturer which, in the Consultant's opinion, meets the basic performance and quality of the specified Product or Manufacturer, subject to all the requirements so specified being met. Dimensions, weights, electrical requirements, are not always equal to the specified item. Except where a Product or Manufacturer is "**basis of design**", an "Acceptable Product" or Manufacturer(s) is named, this Division may supply and install the "Acceptable Product" but must be prepared to bear any and all costs incurred by its use. The Prime Mechanical Contractor is responsible to pay for all Mechanical, Electrical, and Structural changes to suit the selected Acceptable Product, all associated consulting fees, and to identify the impact of the Project schedule.
- .3 The terms "Base Bid" and "Alternate Products" are used to indicate a **preferred Product (base bid)** and a list of potential substitutes (Alternate Product). "Alternate Products" are the only possible alternates for the Base Bid Product. The Prime Mechanical Contractor will list on his tender form, the saving associated with the Alternate Product. The Prime Mechanical Contractor is responsible to pay for all Mechanical, Electrical, and Structural changes to suit the suggested Alternate Product, all associated consulting fees, and to identify the impact of the Project schedule.
- .4 Any equipment installed without the Consultant's written approval is to be removed and the correct equipment installed at this Division's expense. No consideration is to be allowed for claims of delay of schedule in this case.
- .5 In the event the approved equipment is not available for any reason, the specified equipment is to be installed; any and all costs incurred are the responsibility of this Division.
- .6 The Consultant reserves the right to accept or reject an alternate without explanation.

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- .7 Unsolicited Alternates:
 - .1 Additional Manufacturers wishing to bid Products other than the Product specified herein, are to submit to Consultant 10 (ten) days prior to tender close a list of three past installations of Products similar to those listed. Complete catalogue data along with deviations from the Product specified are to be noted in the submittal to the Consultant. The Manufacturer guarantees the proposed substitute Product to comply with the Product specified and as detailed on the Drawings, unless the deviations are so noted in the submittal for approval.
 - .2 The Prime Mechanical Contractor is responsible to pay for all Mechanical, Electrical, and Structural changes required to suit the alternate Product.

2.2 Access Doors

- .1 The Prime Mechanical Contractor to supply access doors of adequate size and with appropriate clearances, wherever any equipment, cleanouts, valves, dampers and fire dampers, which require service, maintenance or removal and are built in or concealed behind walls, or ceiling. Doors to be installed by the General Contractor. Coloured thumb tacks are to be used in acoustic tile ceilings.
- .2 Access doors to be 14 U.S.S. gauge prime coated steel with concealed hinges, anchor straps, screwdriver operated lock, rounded safety corners and dust tight doors that open 180 degrees. Doors are to be adequately sized to suit equipment which is to be accessed, but in no case smaller than 8" x 8" (200 mm x 200 mm).
- .3 In acoustic tile ceiling, where access cannot be achieved through tile, install access doors to suit tile. Markers are to be approved colour-coded markers to indicate type of valve or equipment concealed.
- .4 Where access doors are to be installed in a fire rated assembly, the access door must have a fire rating equal to or greater than the assembly fire rating. Fire rated access doors to be ULC rated and in accordance with NFPA-80.
- .5 Acceptable Products:
 - .1 Acudor
 - .2 Le Hage
 - .3 Mi-Fab

2.3 Concrete Bases & Supports

- .1 This Division shall furnish and install all special Structural Work required for the installation of mechanical equipment and motors. All details to meet the approval of the Consultant and Drawings are to be submitted for all major steel supports.
- .2 Where on the Drawings or Specifications special isolation bases are noted, these shall be the responsibility of this Division.
- .3 All equipment shall be properly aligned on bases before being bolted down.
- .4 All floor-mounted equipment to be set at least 4" (100 mm) above the floor on concrete bases and anchored securely with anchor bolts unless indicated otherwise. Installation of bases and all associated Work to be by Division 3, identified accurately by this Division as to location and dimensions.

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- .5 For precast concrete slabs, this Division shall co-ordinate all openings for pipes and ducts with the Precast Concrete Erector. The Precast Concrete Erector shall be responsible for drilling or cutting all holes through precast slabs. Holes through structural slabs to be sleeved as specified by Division 15.

2.4 Hangers & Inserts

- .1 All inserts shall be Powers Fasteners or Hilti and shall be firmly secured to the framework before concrete is poured. Supply and install these inserts and be responsible for their correct locations. There shall be no flame cutting of structure unless approval is received from the Consultant.
- .2 Any additional supports required from concrete floors or walls for piping or ducts shall be provided by:
 - .1 Drilling same and using steel anchor shield and bolt
 - .2 Toggle or expansion bolt
- .3 Hangers shall be secured to concrete block by:
 - .1 Steel anchor shield and bolt
 - .2 Toggle or expansion bolt
- .4 Hangers shall be secured to steel structures by:
 - .1 Punching flanges for bolt
 - .2 Friction lug or flange
 - .3 'C' clamp or beam clamp
 - .4 Tack welding as conditions require
- .5 Steel deck shall not be used to support ducts, pipes, fixtures and equipment except on written permission of the Structural Consultant.
- .6 Ensure that load on building structure does not exceed maximum mechanical loading per square foot (metre) shown on Structural Drawings or as directed by the Architect. Take special care to avoid introduction of undue reaction forces into structure of building, to flanges of pumps and equipment, to expansion joints and to piping.
- .7 Take special care to avoid introduction of undue reaction forces into the structure of the building, to flanges of pumps and equipment, to expansion joints, and to piping.

2.5 Factory Installed Controls

- .1 Equipment with factory installed controls shall have transient (surge) suppression installed in parallel with the holding coils of all starters and relays as protection for equipment sensitive to surges and spikes, when required.

PART 3 - EXECUTION

3.1 Installation

- .1 Each piece of equipment or material to be checked against the Specification and reviewed Shop Drawing before installation, all clearances and installation instructions are to be strictly adhered to. Failure to comply with the instructions shall result in removal and proper reinstallation of the equipment at no cost to the Owner.

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- .2 Where mechanical equipment is installed in a fire rated assembly, Provide fire dampers, drywall enclosure or other as required to maintain the assembly fire rating to the approval of this Division. Include all costs.

3.2 Sleeves, Holes & Patching

- .1 All holes, pipe chases, and openings through walls and floors that are not fire separation are to be large enough to accommodate the thickness of insulation specified.
- .2 All cutting and patching, sleeves, grouting, painting and drywall required by this Division is to be performed by fully qualified craftsmen of that respective trade. All cutting and patching required by this Division to be provided by this Division, unless indicated otherwise.
- .3 All holes, pipe chases and openings through walls and floors that are fire separations are to be 1/2" (13 mm) larger in diameter than the pipe and the void will be properly fire stopped as specified.
- .4 Holes through masonry walls are to be sleeved with schedule 40 steel pipe, all other holes to be sleeved with light gauge metal sleeves, unless indicated otherwise.
- .5 Holes through exterior walls and roof are to be properly flashed and made weatherproof. Refer to Architectural Drawings for details.
- .6 Holes through structural steel are to be reinforced with steel plates welded each side as detailed in the Structural Engineer's Drawings and Specifications or to meet their approval.
- .7 Sleeves for uninsulated pipes are to be sized to allow 1/2" (13 mm) clearance between the pipe and the sleeve. The space between the pipe and sleeve to be sealed with rockwool insulation to avoid smoke, sound and dust transmission and fire stopped.
- .8 Pipes are not to be in direct contact with plaster, concrete or any other finishing material.
- .9 Sleeves for all piping penetrating mechanical room floor to extend 2" (50 mm) above the finished floor and sealed at the floor.
- .10 Sleeves in potentially wet floor areas to extend at least 1" (25 mm) above the finished floor.
- .11 Ensure no contact between copper tube or pipe and ferrous sleeve.
- .12 The Prime Mechanical Contractor to provide detailed dimensioned Drawings prior to pouring floors, erecting masonry, or installing roof deck. Drawings to indicate size and location of all openings to ensure correct bridging installed as indicated under Division 5.
- .13 The Prime Mechanical Contractor is responsible to install sleeves for piping and ducts and frames for openings for grilles, and louvers, as the construction progresses. If these sleeves and frames are not installed by this Division during construction the cost of cutting openings, chases and installing the sleeves and frames is to be at This Division's expense by the respective trade involved.
- .14 Provide sleeves for all ducting penetrating floors and masonry or concrete walls
- .15 Ducts penetrating fire separations to have any voids between the duct sleeve and fire separation properly fire stopped as specified. Ducts penetrating non fire separations to have any voids between the duct sleeve and separation filled with rockwool insulation to avoid smoke, sound and dust transmission.

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- .16 Supply and set all necessary sleeves for this Work prior to pouring of concrete.
- .17 Approval of the location, size and proposed method of cutting through structural components must be received before proceeding.
- .18 Where pipe and ducts pass through walls in the existing building, the cutting and patching is by the Prime Mechanical Contractor.
- .19 Where pipes and ducts pass through fire separations (walls, floor and partitions) pack space with ULC listed and/or approved fire stopping mineral fibre insulation and seal with approved fire-retardant sealing compounding. Sealing compound to be installed to Manufacturer's Specifications and detail. Fire stopping shall comply with the Ontario Building Code and approved by local Building Department. Obtain written approval from Local Building Department before commencing with Work.

3.3 Workmanship

- .1 Employ an experienced, responsible tradesperson to supervise the Work and retain this supervisor on the job throughout the construction period until completion of Work, and all mechanical systems are fully operational and have been commissioned and demonstrated to the Owner unless otherwise approved or directed by the Consultant.
- .2 Employ only skilled licensed pipe fitters for execution of Work. Workmanship to be first class not only as regards durability, efficiency and safety, but also as regards to neatness of detail.
- .3 Set equipment accurately, plumb and level and align hanger rods and steel supporting structures.
- .4 Products and installations in the opinion of the Consultant found to be defective; not in accordance with Specifications; damaged or defaced; or of poor workmanship to be rejected.
- .5 Rejected Work is to be repaired or replaced at no cost to the Owner.

3.4 Use of HVAC Fans

- .1 While construction is still in progress, the use of or running of system ventilation fans for the purposes of ventilation, drying of plaster, sanding, painting, etc., will not be permitted.

3.5 Belt Drives, Sheaves & Guards

- .1 Provide all belt driven equipment with V-belt drive, designed for at least 150 percent of motor nameplate horsepower rating and in accordance with Manufacturer's recommendations for type of service intended. Belt drives to be at least 95 percent efficient. Balance and properly align all drives. Provide matched sets of belts for multiple belt assemblies. Select belts to suit starting torque of driver. Use single belt drives only for motors 2 HP (1492 watt) and smaller.
- .2 Provide motor sheaves for one and two belt drives of variable pitch type, with Dodge key adjustments. Supply one set of fixed drive sheaves for drives with two or more belts. Install fixed motor sheaves to obtain the originally specified rpm. After initial test and preliminary adjustment, supply and install a second set of fixed sheaves if necessary, to provide the design flow quantities as established on the job. Obtain correct total flow rate for fans through speed changes and not by throttling.

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- .3 All equipment that is belt driven must be a complete installation including a sturdy, firmly supported, removable belt guard to give full protection and safety from any rotating part.

3.6 Piping

- .1 All piping for this Division is to be run concealed and grouped so that valves, etc., are accessible through as few access panels or doors as possible, while still maintaining adequate working space.
- .2 Piping that does not present a neat workmanlike appearance, in the opinion of the Consultant, is to be reworked according to his instructions without extra cost to the Owner. Arrange piping within pipe chases that have been designed for access of personnel to ensure that access is not impeded.
- .3 In specifically designated unfinished areas such as mechanical rooms or existing areas, run pipes neatly parallel or in banks and group valves. Piping may run exposed in these designated areas. The crossing over of pipes must be kept to a minimum.
- .4 The piping shown on the Drawings is located diagrammatically in the space in which it is intended to run. Co-operate and co-ordinate with the Work of other Divisions, also installing pipes, conduits, ducts, etc., within the same area. No extras are to be paid for any relocation of piping to suit the Work of other Divisions.
- .5 Separation by approved dielectric unions is to be applied to all ferrous and non-ferrous domestic water piping. Separation of ferrous and non-ferrous piping on closed loop systems to be accomplished with the use of brass or bronze fittings and/or valves. All connecting or touching metals that could give rise to electrolytic action to be separated by insulation.
- .6 All piping is to be installed with adequate change of direction, expansion joints and anchors, so that the piping and equipment will in no way be strained or distorted by expansion and contraction.
- .7 If on the job circumstances require additional change of direction and expansion loops, furnish and install same at no extra cost.
- .8 All take-offs from the mains to be made using swing joints wherever possible.
- .9 Hydronic branches serving down feed risers are to be taken from lower sides or bottom of mains and grade down slightly to risers. Branches which serve units above the mains are to be taken from the top or sides of mains.
- .10 Anchors are to be provided where necessary to protect equipment and to generally be made from 1/2" (13 mm) M.S. plate with structural steel angle and channel sections.
- .11 Suitable anchors and guides are to be provided where shown or where necessary for all vibration devices.
- .12 Expansion loops are to be located midway between anchors except where shown otherwise. All expansion loops to be cold sprung 50% in accordance with the latest edition of the ASHRAE Guide.
- .13 Install all water piping so that lines can be drained. Provide drip tee with 3/4" (19 mm) ball valve with cap and chain.
- .14 All exposed plumbing piping in finished area to be chrome plated unless indicated otherwise.

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3.7 Identification of Piping

- .1 Identify all visible piping whether fully exposed or in accessible spaces such as above acoustic tile ceilings.
- .2 Identify all concealed piping mains in concealed areas such as drywall ceilings and pipe trenches etc. prior to these areas being enclosed.
- .3 Identify the medium in the piping with wrap-around pipe markers including direction-of-flow arrows.

Medium in Pipe	Background Colour	Lettering Colour	Notes
Domestic Cold Water	Green	White	
Domestic Hot Water	Yellow	Black	
Domestic Hot Water Recirculation	Yellow	Black	
Tempered Water	Yellow	Black	
Sanitary Drain	Green	White	
Storm Drain	Green	White	
Plumbing Vent	Green	White	
Natural Gas	Yellow	Black	
Heating Water Supply	Yellow	Black	
Heating Water Return	Yellow	Black	
Condensate	Yellow	Black	
Sprinkler Water	Red	White	

- .4 All piping identification to be done on clean surfaces.
- .5 Size all wrap-around labels for the pipe being labelled.
- .6 Location:
 - .1 Locate markers and classifying colour on piping systems so they can be seen from floor or platform.
 - .2 Identify piping runs at least once in each room.
 - .3 Do not exceed 50 ft. (15 m) between identifications in open areas and above T bar ceilings.
 - .4 Identify both sides where piping penetrates walls, partitions and floors.
 - .5 Where piping is concealed in pipe chase or other confined space, identify at point of entry and leaving, and at each access opening.
 - .6 Identify piping at starting and ending points of runs and at each piece of equipment.
 - .7 Identify piping at major manual and automatic valves immediately upstream of valves. Where this is not possible, place identification as close to valve as possible.
 - .8 Identify branch, equipment or building served after such valve.
 - .9 Identify piping in concealed spaces prior to spaces being enclosed.
- .7 Labels shall comply with WHMIS and ANSI Specifications.

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- .8 Acceptable Products:
 - .1 Brimar Industries
 - .2 Seton Inc.

3.8 Valve Tags

- .1 All valves installed under this Division to have securely affixed to them an approved valve tag bearing an engraved number which shall be used to identify the valve on an indexed valve list prepared and mounted in a glazed frame in the mechanical or boiler room.
- .2 Beside each number on the list of valves to be listed, identify the function normal position, and location of valve so tagged.
- .3 Valve tags shall be either engraved lamacoid or plastic valve tags (Brimar B11101-39) with 8 mm (1/4") tall lettering of a colour to contrast with the label colour.
- .4 Valve tags shall be colour coded as follows:

System	Tag Colour	Lettering Colour
Domestic piping systems	Green	White
Heating water piping systems	Yellow	Black
Fire Protection piping systems	Red	White

- .5 **Identification Charts:** The Prime Mechanical Contractor shall provide three (3) copies of typewritten identification charts identifying the tag numbers, location and service of each valve, and part number. One (1) copy is to be framed in glass in each Mechanical Room. Mount 6'-0" (1800 mm) above floor to bottom. The remaining charts shall be placed in the Maintenance Manuals.
- .6 **Valves:** Only normally closed valves and special valves shall be identified. Nameplate shall spell out requirement, i.e. "Normally Closed".
- .7 Control valves shall be identified as to their service.
- .8 Acceptable Products:
 - .1 Brimar Industries
 - .2 Seton Inc.

3.9 Identification of Ductwork

- .1 Stencil over final finish only.
- .2 Use 2" (50 mm) high black stencilled letters, e.g. "Supply", "Return", "Washroom Exhaust", "General Exhaust" with directional flow arrows.
- .3 Maintain 50' (15 m) maximum distance between markings, with at least one identification per run.
- .4 Identify ducts each side of dividing walls or partitions and beside each access door.

3.10 Identification of Equipment

- .1 Provide laminated plastic plates with black face and white centre of minimum size 3-1/2" x 1 1/2" x 1/16" (90 x 38 x 2 mm) nominal thickness, engraved with 1/4" (6 mm) high lettering. Use 1" (25 mm) lettering for major equipment.

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- .2 Include Electrical circuit designation on the label.
- .3 Mechanically fasten nameplates securely in conspicuous place. Where nameplates cannot be mounted on cool surface, provide standoffs or hang from equipment on short metal chain.
- .4 Identify equipment type, number, and service or areas or zone of building served.
- .5 Submit the wording for the labels for review prior to engraving and installation.
- .6 **Fire Dampers:** Mark each fire damper location by marking the ceiling grid with a **YELLOW** 1/4" (10 mm) diameter dot at each corner of the tile to be removed for servicing the fire damper. Staples Model AVE14005.
- .7 **Circuit Balance Valves "CBV":** Mark each circuit balance valve location by marking the ceiling grid with a **GREEN** 1/4" (10 mm) diameter dot at each corner of the tile to be removed for servicing the valve. Staples Model AVE14002.
- .8 **Concealed Fan Equipment:** Mark each location by marking the ceiling grid with a **BLUE** 1/4" (10 mm) diameter dot at each corner of the tile to be removed for servicing the equipment. Staples Model AVE14003.
- .9 **Trap Seal Primers "TSP" and "TSP-1":** Mark each circuit balance valve location by marking the ceiling grid with a **RED** 1/4" (10 mm) diameter dot at each corner of the tile to be removed for servicing the equipment. Staples Model AVE14001.
- .10 Provide a clear mylar nameplate adhered to the ceiling track where each fire damper; heating and water shut-off valve; circuit balancing valve; reheat coil and temperature control valve is installed in the ceiling space.

3.11 Painting

- .1 All field priming and finishing to be performed by Division 9.
- .2 Provide field surface preparation, priming and finishing of the Work of this Division including exposed bare (or insulated) pipework, fittings, ductwork, miscellaneous metals, supports, and equipment, in accordance with Division 9.
- .3 All exposed structural members required for supporting piping, ductwork, and equipment shall be painted one (1) base coat and one (1) finish coat. Colour to be determined by the Architect. Where threaded rods are used, they shall be cadmium plated including washers and nuts.
- .4 The Prime Mechanical Contractor shall paint flat black all relief and drain pipes serving mechanical equipment.
- .5 The Prime Mechanical Contractor shall paint pipe sleeves one coat primer.
- .6 Leave all work in a clean, paintable condition.

3.12 Placing In Operation

- .1 Prior to acceptance and on completion of Work make a complete operational test of systems and Work carried out under Division 15.
- .2 At all fixtures, adjustments for correct water flow to be made; this is to include hot and cold water systems and flush valves.
- .3 At all drains, covers and gratings are to be removed and cleaned, traps cleaned out and drains thoroughly flushed.

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- .4 All strainers are to be cleaned out after two weeks normal operation.
- .5 All filters in HVAC equipment are to be removed, thoroughly cleaned and stored for future use, install new filters in units. Bird and insect screens on all louvres to be cleaned. All coils to be combed out where necessary and vacuumed out.
- .6 Balancing will be carried out and systems set to designed values, and a report of final actual performance of all equipment and balancing for final space conditions on cooling and heating to be carried out when relative climatic conditions exist. Refer to Section 15013 - Systems Balancing for more details.
- .7 During the one (1) year guarantee period, commencing after Substantial Completion letter issued by the Architect's office, maintain all equipment installed as part of this Division. This agreement shall be part of the written guarantee. This Work shall be carried out in the presence of the building custodian, and a letter shall be sent to the Consultant stating that this Work was carried out. Three (3) maintenance inspections must be carried out by the Contractor during this one (1) year period (three months, six months, and twelve months after Substantial Completion letter issued). Submit written report to Owner and Consultant after each inspection.

3.13 Clean-Up

- .1 Avoid accumulation of scrap and debris resulting from the operations of this Division and at all times help maintain the working site in a neat and clean condition. On completion of the Contract, remove all scrap and debris resulting from the Work of this Division and clean all equipment installed by this Division.

3.14 Start-Up Service

- .1 Provide services of a qualified technician responsible for assisting the Owner's staff in becoming familiar with operating of systems, co-ordinating Work of control Manufacturer, acting on any complaints from the Owners, or Consultant regarding operation of any of the systems, installed under this Division.
- .2 Provide start-up of major pieces of mechanical equipment or systems, by representative of equipment Manufacturer or person qualified and recognized by the equipment Manufacturer.
- .3 Submit start-up reports on all mechanical equipment and systems verifying correct installation and operating parameters in all modes of operation. Include service reports in operating and maintenance manuals.
- .4 Notify Consultant prior to start-up on any piece of mechanical equipment or system. Demonstrate operation of all or any mechanical system or equipment as directed by the Consultant in his presence.
- .5 Co-ordinate with the Commissioning Agent for mechanical equipment start-up.
- .6 When the sign off procedure is complete, the Prime Mechanical Contractor shall instruct the Owner's designated representative in the operation and maintenance of all equipment.

3.15 Completion

- .1 Keep the premises in a clean and orderly condition during construction. All waste and unusable materials shall be promptly removed from the site.

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- .2 Upon completion of this Work, go over the entire installation, clean and polish all fixtures and equipment, and remove all surplus materials and rubbish of every description incidental to this Work, leaving the installation neat and orderly.
- .3 Before final payment is made, the following items must be completed:
 - .1 Present to the Consultant "Maintenance Manuals" complete with air and water balancing reports, wiring diagrams and certified equipment prints (approval Drawing submissions).
 - .2 Present to the Consultant an as-built record set of Drawings and CAD disk.
 - .3 Instruction of Owner's personnel in the maintenance and operation of all new equipment.
 - .4 Instruction of Owner's personnel in the treatment of water in new heating system.
 - .5 Present to the Consultant complete controls commissioning report.
 - .6 Present to the Consultant completed Equipment Start-up and Acceptance Checklists.
 - .7 Present to the Consultant plumbing Test Certificates and results.
 - .8 ERV Unit and Boiler Start-Up Reports
 - .9 Present to the Consultant Valve Tag Charts.
 - .10 New spare filters and frames labelled and located where directed by the Owner.
 - .11 Present to the Consultant as-built Drawings sprinkler on CAD diskette.
 - .12 Operating key for exterior hose bibb to be turned over to the Owner.
 - .13 Locking wrench for washfountains to be turned over to the Owner.
 - .14 Maintain a set of approved Drawings on site available for review by TSSA.
 - .15 Ensure that all welding and brazing are done by qualified operators certified by the TSSA, using appropriate procedures registered by the TSSA.
 - .16 Advise the Consultant at least 48 hours in advance of any scheduled TSSA inspections.
 - .17 Perform the above Work and other TSSA requirements in a timely manner so as not to interfere with the progress of the Project.
 - .18 Present to the Consultant Rooftop Equipment Start-Up Reports.
 - .19 Pay all permit and inspection fees.
- .4 A value of 1% of the total Contract price shall be withheld until points 3.15.3.1 to .19 are completed to the satisfaction of the Consultant.

3.16 Rigging of Equipment

- .1 Provide all rigging, hoisting and handling of equipment as necessary in order to place the equipment in the designated area in the building.
- .2 Direct this Work by qualified people normally engaged in rigging, hoisting and handling of equipment.

3.17 Field Welding

- .1 Only persons who have passed welding tests to the satisfaction of the Authorities having jurisdiction and who are certified by them to be qualified welders, shall be permitted to do any welding on this Contract.

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3.18 Cold Weather Work

- .1 Wherever Work is performed in surrounding air temperatures below 40°F (4°C) special approved precautions shall be taken to prevent damage to mortar, concrete or materials. All such materials used at such times shall be heated. Right is reserved to suspend Work at any time should climatic conditions be deemed unsuitable for proper execution of Work.

3.19 Rights Reserved

- .1 Rights are reserved to furnish any additional Detail Drawings which, in the judgement of the Consultant, may be necessary to clarify the Work and such Drawings shall form a part of the Contract.

3.20 Superintendence

- .1 Maintain at this job site, at all times, qualified personnel and supporting staff with proven experience in erecting, supervising, testing and adjusting projects of comparable nature and complexity.

3.21 Special Cleaning

- .1 Vacuum clean and remove debris from the inside of fans, ducts, coils, terminal units, etc.
- .2 Comb all bent fins to proper configuration on all coils in air handling units, fan coil units, entrance heaters, etc., on finned radiation elements.

3.22 Moving, Hoisting & Scaffolding

- .1 The Prime Mechanical Contractor is responsible for moving, hoisting and demurrage for all equipment and materials to be furnished and installed under this Division. Include for the cost of dismantling and reassembling equipment, where required, to the Manufacturer's approval.

3.23 Time For Completion

- .1 Review the general Contract requirement for completion dates. Identify at the time of tender any items which may affect the time for completion.
- .2 Advise the Architect and Consultant if materials and equipment involves longer delivery times than indicated in the schedule.
- .3 Monitor and expedite delivery of equipment and materials. If necessary, inspect at source of manufacture.
- .4 Be responsible for failure of, or delay in, the delivery of specified equipment.

3.24 Tender Instructions

- .1 The Prime Mechanical Contractor shall fax the attached sub-Contractors list and Alternate Products list to the Consultant within twenty-four hours of Mechanical Trade Tender Closing.
- .2 The Prime Mechanical Contractor agrees to employ those Sub-Contractors proposed in the Mechanical Form(s) of Tender and accepted by the Owner at the signing of the Contract with the General Contractor.

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- .3 The Owner may, for reasonable cause, object to the use of a proposed Sub-Contractor and consequently, may require the Division 15 Contractor to employ one of the other Sub-Contractor bidders.
- .4 In the event that the Owner requires a change from a proposed Sub-Contractor, originally proposed by the Division 15 Contractor, the Contract Price shall be adjusted by the difference in cost.
- .5 The Prime Mechanical Contractor shall not be required to employ as a sub-Contractor a firm to whom he may reasonably object.
- .6 Work of Sub-Contractors named at the time of Tender or substitutions authorized by the Owner will be recognized as being in accordance with the Contract Documents and any payments will be approved by the Owner, only to such Sub-Contractors.
- .7 The Prime Mechanical Contractor proposes to use the following sub-Contractors, the portion to be performed by each being as indicated.

Sub-Contract	Company	Contact Person	Phone/Fax/E-Mail	Percentage of Contract
Insulation				
Plumbing & Drainage				
Fire Protection (Sprinklers)				
Heating & Piping				
Sheetmetal				

3.25 Alternate Products

- .1 As per Standards of Materials and Equipment, where Base Bid Specification is used, the bid shall be based on the specified Base Bid equipment.
- .2 The Contractor may list below, alternate equipment with cost savings for review. The Owner is under no obligation to accept alternate equipment.

Equipment Description	Alternate Product & Cost Savings

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Equipment Description	Alternate Product & Cost Savings

3.26 TSSA Inspection

- .1 The Prime Mechanical Contractor shall pay all fees, Site Visits and Inspections in connection with TSSA Inspection for all services.

3.27 Testing & Adjusting

- .1 Test all piping systems for leaks providing gauges, materials and labour as required. Equipment furnished as part of the permanent installation shall not be used for testing purposes. Before testing, remove all equipment which is not designed to withstand the test pressures. All piping is to be tested before covering is applied, and before backfilling or concealing.
- .2 **Hydrostatic Tests:** All pressure pipe is to be tested as described in each Section. Test pressure shall be maintained for the times noted, during which time the pressure test shall remain constant without pumping.
- .3 **Gravity Piping:** All gravity drainage piping shall be given a ball test and a water test, which must be supervised and inspected by the local Plumbing Inspector.
- .4 All testing shall be done to the satisfaction and approval of the Consultant and the Division shall notify the Consultant forty-eight (48) hours prior to testing.
- .5 Before final payment, test the operation of each system and all equipment installed, make all necessary adjustments and replacements, and demonstrate to the satisfaction of the Consultant that all equipment is operating as intended and without undue noise and vibration.
- .6 If system pumps are used during the system flushing, Division 15 shall supply and install replacement pump seals in each pump, once flushing is complete and tests results accepted.
- .7 When work is complete and systems are in operations, adjust valves, belt drives, controls and thermostats so that there is an even distribution of cooling and heating throughout. Turn over to Owner necessary keys, handles, and operating devices for each system.
- .8 Test for both heating and cooling design days.
- .9 All tests must be witnessed by the Commissioning Agent. Failure to do so will result in a re-test.

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3.28 Flashing

- .1 The Prime Mechanical Contractor shall Provide flashings for the Work of this Division. If not specified, a description is to be supplied for approval.
- .2 Generally, all pipes and small ducts or stacks passing through the roof shall be flashed with a 18-gauge steel sleeve soldered watertight and fastened to the roof deck before the roofing is applied, with a minimum of 8" (200 mm) overlap along the roof deck and extending 8" (200 mm) up the pipe or duct, sealed with a weather skirt.
- .3 Vent stacks may be flashed with patented flashing cones provided with the equipment.
- .4 Where large ducts pass through the roof, curbs and flashing shall be by the General Division where shown on the roofing plan. If not shown, all curbs, flashings, and counter flashing are by the Prime Mechanical Contractor.

3.29 Temporary or Trial Usage

- .1 Do not use any permanent Mechanical Systems during construction unless specific written approval is obtained from the Architect.
- .2 Temporary or trial usage of any mechanical device, machinery, apparatus, equipment or materials shall not be construed as evidence of acceptance of same and no claim for damage shall be made for injury to or breaking of any part of such Work which may so be used.
- .3 Where the Owner permits the use of a system the Prime Mechanical Contractor shall be in charge of and maintain all equipment in accordance with Manufacturers instruction at all times the systems are in operation.
- .4 The use of permanent systems shall not invalidate the guarantee or warranty.
- .5 Prior to final acceptance, return all equipment to as new condition and provide Supplier certification of same.

3.30 Provision for Future

- .1 Provide valves and piping as shown or required to extend plumbing and heating systems in future. Valves and piping shall be arranged so extensions can be made without shutting off existing systems.

3.31 Commissioning

- .1 The Owner has retained a CFMS as the Commissioning Agent for this project to provide commissioning services for Mechanical Equipment and systems. Refer to Section 01005 in the Architectural Specification. Allow for a minimum of 40 hours to coordinate, demonstrate and trouble-shoot mechanical systems to the Commissioning Agent.



Transfer of Files on Electronic Media

Consultant of Record ("Consultant"): EXP Services Inc.

Contractor ("Contractor"): []

Re: St. Aloysius Catholic Elementary School - Addition 504 Connaught St, Kitchener ON N2C 1C2 ("Owner"): Waterloo Catholic District School Board

The Contractor hereby acknowledges requesting from the Consultant, electronic data containing graphic (electronic) representation of Engineering Drawings as per attached list of Drawings, subject to the condition that the said Drawings are to be used only for information and reference in connections with the Owner's use and occupancy of the Project. The Contractor shall be responsible for checking and verifying all dimensions and details, or quantities of materials and for the co-ordination of architectural, structural, mechanical and electrical elements as required to facilitate complete and accurate fabrication and installation. Any omissions and discrepancies shall be reported to the Consultant. The Contractor hereby warrants to the Consultant that the Drawings will only be used for development of Shop Drawings/Record Drawings. The Drawings shall not be used for any other project **or purpose** either by the Contractor or others. The Contractor further warrants not to alter the electronic data or the information contained therein, in any way except for the above noted purposes, and acknowledges that such unauthorized use or alteration of the original work is protected in accordance with the Copyright Act and subject to penalties prescribed therein.

The Contractor hereby acknowledges that the said electronic data contain information which may be updated or altered at any time by the Consultant, and that it is the responsibility of the Contractor to make themselves aware of these changes, in a timely manner. In the event of a conflict between the Drawings issued to the Contractor and the sealed Contract Drawings, the sealed Contract Drawings shall govern.

By accepting the Drawings, the Contractor has in no way purchased the Drawings or any rights to the Drawings or the information contained therein, and the Contractor may only alter the Drawings for the purposes noted above.

The electronic files will be provided in AutoCAD format (Version 2000 or more recent). The Consultant makes no representation as to the compatibility of these files with the Contractors hardware or software beyond the specified release of the referenced software.

The Contractor shall, to the fullest extent permitted by law, indemnify, defend and hold harmless the Consultant, and its Sub-Consultants from all claims, damages, losses, expenses, penalties and liabilities for any kind, including attorney's fees, arising out of, or resulting from the use of the electronic data by the Contractor, or by third party recipients of the electronic data from the Contractor.

The Consultant believes that no licensing or copyright fees are due to others on account of the transfer of the electronic media, but to the extent any are, the Contractor will pay the appropriate fees and hold the Consultant harmless from such claims.

Any purchase order number provided by the Contractor is for Contractor's accounting purposes only. Purchase order terms and conditions are void and are not part of this agreement.

The laws of the Province of Ontario shall govern this agreement.

The conditions and undertakings expressed wherein apply to partners, employees, agents, successors, assigns and legal or other representatives of the Contractor.

Dated at _____ this _____ day of _____, 20____.

Authorized Acceptance by Consultant

Signature

Print Name and Title

Date

By Contractor

Signature

Print Name and Title

Date

ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL - ADDITION
504 CONNAUGHT ST, KITCHENER ON N2C 1C2
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PART 1 - GENERAL

1.1 Requirements Included

- .1 Shop Drawings and Product data.
- .2 Working/Interference Drawings.
- .3 As-built Drawings.
- .4 Operating and maintenance manuals including extended warranties.

1.2 Related Work Specified Elsewhere

.1	System Balancing	Section 15013
.2	Basic Materials & Methods	Section 15050
.3	Water Treatment	Section 15051
.4	Electric Motors	Section 15054
.5	Sound & Vibration Control	Section 15160
.6	Insulation	Section 15180
.7	Plumbing	Section 15400
.8	Plumbing Fixtures & Trim	Section 15401
.9	Sprinkler Systems	Section 15510
.10	Fire Extinguishers	Section 15540
.11	Liquid Heat Transfer	Section 15700
.12	Hot Water Heating Devices	Section 15701
.13	Pumps	Section 15702
.14	Natural Gas Equipment	Section 15705
.15	Air Distribution - General Provisions	Section 15800
.16	Air Distribution - Duct Construction	Section 15801
.17	Air Distribution - Ductwork Accessories	Section 15802
.18	Air Distribution - Grilles & Diffusers	Section 15804
.19	Air Distribution - Air Filters	Section 15805
.20	Air Distribution - Commercial Fans	Section 15808
.21	Air Distribution - Energy Recovery Ventilators	Section 15813
.22	Controls & Instrumentation	Section 15900
.23	Refrigeration	Section 15950
.24	Refrigeration - Air Conditioning Equipment	Section 15952

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1.3 Administrative

- .1 Submit to Consultant submittals listed for review before fabrication of any materials and/or equipment. Submit with reasonable promptness and in an orderly sequence so as to not cause delay in the construction schedule. Failure to submit in ample time is not considered sufficient reason for an extension of the Construction Schedule and no claim for extension by reason of such default is allowed.
- .2 Work affected by the submittal is not to proceed until the review is complete unless an approval is obtained from the Consultant.
- .3 Review submittals prior to submission to the Consultant. This review represents that necessary requirements have been determined and verified, and that each submittal has been checked and co-ordinated with the requirements of the Contract Documents.

1.4 Shop Drawings

- .1 Submit Shop Drawings as required in various sections of these Specifications and on the Drawings.
- .2 Shop Drawings to be submitted with a cover sheet(s) on the Contractor's letterhead listing the following information:
 - .1 Project:
 - .2 Owner/Client:
 - .3 Mechanical/Electrical Consultant:
 - .4 Mechanical Contractor:
 - .5 Supplier
 - .6 Specification Section
 - .7 Materials or Equipment submitted
- .3 Include space for review stamps by Consultant, General Contractor, and the Prime Mechanical Contractor.
- .4 Prepare and submit for review, where specified, shown or considered necessary by the Consultant, Shop Drawings showing details of Work as follows:
 - .1 Fabrication and erection dimension.
 - .2 Sections, arrangements and details which indicate complete construction as well as interconnections with other Work.
 - .3 Location and type of anchors and fastenings.
 - .4 Materials including gauges, thickness, sizes and finishes.
 - .5 Descriptive names of equipment and mechanical and electrical characteristics when applicable.
 - .6 Data verifying that superimposed loads will not affect function, appearance, and safety of Work shown on Shop Drawings as well as other Work interconnected.
 - .7 Assumed design loadings, dimensions of elements and materials Specification for load bearing members.
 - .8 Complete composite wiring diagrams as required by Division 16 of each mechanical system. Indicate all electrical requirements both internal and external for review and co-ordination of other trades.
 - .9 Indicate all accessories and clearances for operation and servicing.

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- .5 Manufacturer's printed data sheets for standard items are acceptable providing pertinent characteristics are identified and relate to specified items. Submit data sheets in electronic format except where specified otherwise.
- .6 Check Shop Drawings and data sheets, before submission, as follows:
 - .1 Against Contract Documents and other applicable Shop Drawings, to ensure that Work adjacent to and affecting other Work is accurately detailed.
 - .2 To ensure that Work shown on Shop Drawings conforms to requirements of Contract Documents.
 - .3 Enclose **NOTICE IN WRITING** of any variations from requirements of Contract Documents.
- .7 Indicate on Shop Drawings that they have been checked by applying stamp "reviewed and certified correct for construction", including date and signature. Drawings and details submitted without such stamp or whenever it is evident that Drawings have not been checked (despite approval stamp) are not to be reviewed and are to be returned to this Division.
- .8 The Consultant's review of Shop Drawings and data sheets pertain to general design only. Errors in dimensions, quantities or interference are to be marked if noticed, but is not in any way to relieve the Contractor from the responsibility to complete the Work as shown and specified.
- .9 All Shop Drawings are to be submitted in metric dimensions.
- .10 Shop Drawings are to be returned with "No Exception Taken", "Make Corrections Noted. Resubmission Not Required", "Revise and Resubmit", and "Rejected, Submit Compliant Product System".
 - .1 **No Exception Taken** - Drawings conform to the general design concept.
 - .2 **Make Corrections Noted** - Resubmission Not Required - Drawings conform to the general design concept except for noted items.
 - .3 **Revise and Resubmit** - Drawings conform to the general design concept subject to the corrections noted. Drawings to be corrected and resubmitted for final review and incorporation into maintenance manuals. Such submission is not to hold up manufacture.
 - .4 **Rejected, Submit Compliant Product System** - Drawings are rejected and manufacture of this equipment is not to proceed. Drawings are to be resubmitted with required corrections on equipment.
- .11 All Shop Drawings must be submitted promptly.
- .12 The Prime Mechanical Contractor is to keep track of the Shop Drawings and the subsequent equipment delivery using a Review Summary Form similar to the form shown below. This form is to be updated and presented at each job meeting until all the equipment is on the job.

1.5 Working/Interference Drawings

- .1 Before commencing any Work, the Prime Mechanical Contractor is to prepare Working/Interference Drawings, to ensure that all components, including any components of other divisions, are to be properly accommodated within the spaces provided, ensuring all clearances required by jurisdictional authorities and for proper maintenance are indicated and maintained.

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- .2 Prepare Drawings to indicate co-ordination and method of installation of a system with other systems where their relationship is critical. Ensure all details of equipment, apparatus and connections are co-ordinated.
- .3 Failure to co-ordinate with all other trades could result in reworking of installed equipment, piping or ducting at the discretion of the Consultant. Any reworking to accommodate the installation of other trades is to be performed at no extra cost.
- .4 Submit two (2) copies of Interference Drawings showing structural members, electrical conduits devices and all mechanical elements to the Consultant for review and general approval before proceeding with the Work.
- .5 Copies of these reviewed Interference Drawings shall be submitted to all trades, the General Contractor, the Architect, and the Consultant, and general approval shall be obtained before the space allotment.
- .6 One (1) set of Interference and Working Drawings shall be turned over the Owner for record purposes.

1.6 Maintenance Data & Operating Instructions

- .1 Submit **two (2)** hard copies of Operation and Maintenance Manual individually bound in suitable sized hard backed three-ring binders. Submit **one (1)** digital copy of Operation and Maintenance Manual
- .2 Front cover of each binder to be suitably lettered, as follows:
OPERATION AND MAINTENANCE
MANUAL FOR
(Project Name)
(Owners Name)
(Date)
- .3 Provide plastic tab indices for all sections of the manual. Provide separate sections for each major piece of equipment and for groups of smaller Products.
- .4 Provide master index at the beginning of each binder indicating all items included in each section.
- .5 Provide list of names, addresses and telephone numbers of equipment Suppliers, Installing Contractors, General Contractors, Architect and Consulting Engineer.
- .6 Provide final review Shop Drawings of each manufactured item in addition to the operating and maintenance instructions.
- .7 Operating instructions to include:
 - .1 General description of each mechanical unit and system.
 - .2 Step by step procedure to follow in commissioning each piece of equipment, including start up, break-in, and routine normal operating instructions and sequences. Include regulation control stopping, shutdown, and emergency instructions. Include summer, winter and any special operating instructions.
 - .3 Schematic control diagrams for each separate system. Each diagram to indicate locations of start-stop switches, insertion thermostats, thermometers, freezestats, firestats, pressure gauges, automatic valves, and accessories. Correct operating settings for each control device to be indicated on diagram.
 - .4 Drawings of each control panel identifying all components on the panels and their function and sequence of operation.
 - .5 All mechanical equipment wiring and control diagrams as installed.

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- .6 Provide original Manufacturers illustrations, Shop Drawings, assembly Drawings and diagrams required for maintenance.
- .8 Maintenance instructions are to include:
 - .1 Manufacturer's printed maintenance instructions for each item of mechanical equipment installed under this Division. Instructions are to include installation instructions, description of the unit or system and component parts numbers and lists, name of Supplier and maintenance and lubrication instructions. Include complete nomenclature and commercial number of replacement parts.
 - .2 Summary list of each item of mechanical equipment requiring servicing and lubrication, indicating the name of the equipment item, location of all points of lubrication, type of lubricant recommended, and frequency of lubrication.
 - .3 Include routing procedures and guide troubleshooting, disassembly, repair and reassembly instructions, alignment, adjusting, balancing and checking instructions.
 - .4 Provide list of Manufacturers spare parts, current prices and recommended quantities to be maintained in storage.
 - .5 Balancing and testing reports.
- .9 Not later than three (3) weeks prior to application for inspection by Consultant for Substantial Performance, submit records and maintenance manuals to Consultant.
- .10 Maintenance Manuals shall contain dimensioned certified prints of each piece of mechanical equipment and Manufacturer's recommended maintenance instructions, air balancing reports, and wiring diagrams. Tabulated at the front of this binder is to be a maintenance schedule for each piece of equipment, and lubricant to be used, and a tabulation of things to be checked at each piece of equipment. Maintenance Manuals shall be presented in ASHRAE GPC4 format. Submit two (2) three-ring, hard-back, black binders
- .11 Maintenance manuals will be requested by the Consultant shortly after the final submission of Shop Drawings. Maintenance manuals must be submitted and approved before training of the Owner's personnel and before a final inspection will be carried out.
- .12 Provide written warranty on this Division's letterhead addressed to the Owner, copied to the General Contractor.
- .13 Furnish complete Operating and Maintenance Manuals to the Consultant or Commissioning Authority or the Owner's Representative for review in accordance with the Commissioning Plan Schedule. Allow a minimum fourteen (14) days for review.
- .14 Furnish Final reviewed Operating and Maintenance Manuals to the Owner/Owner's Representative fourteen (14) days prior to scheduled Functional Tests.

1.7 Extended Warranties

- .1 This Division is to submit extended warranties for specific materials and/or Work specified in their respective sections.
- .2 Extended warranties are to be issued on the Manufacturers or respective Contractor's letterhead, under seal, and issued in the name of the Owner.

MECHANICAL SHOP DRAWING REVIEW SUMMARY							
EQUIPMENT DESIGNATION	TARGET SUBMITTAL DATE	EQUIPMENT SUPPLIER			DATE OF DRAWINGS TO CONSULTANT	STATUS	DATE DRAWINGS RETURNED
		NAME	CONTACT	PHONE NO.			

STATUS LEGEND:

'A' - No Exception Taken

'C' - Make Corrections Noted, Resubmission Not Required

'B' - Revise & Resubmit

'D' - Rejected, Submit Compliant Product/System

ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL - ADDITION
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Systems Balancing

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PART 1 - GENERAL

1.1 Requirements Included

- .1 The Mechanical Division shall engage a qualified Testing Company to perform the air and water balance specified. The Contractor is to be responsible for ensuring that all systems are operating prior to the balancing agency arriving on site and assisting the balancing agency providing any necessary information, repairing failed equipment, providing proper access to equipment etc. In addition, any additional drive changes, pulleys, etc. necessary to achieve the specified values is to be the responsibility of Division 15 and not of the Balancing Agency. Only one Company will be engaged for both air and water balancing.
 - .1 Dynamic Flow Balancing Ltd., Oakville, Ontario (Phone: 905-338-0808)
 - .2 Air Audit, Cambridge, Ontario (Phone: 519-740-0871)
 - .3 Flowset Balancing, Oakville (Phone: 416-410-9793)
 - .4 Clark Balancing & Hydronic Testing & Balancing, Milton (Phone: 905-693-1518)
- .2 Conform to the requirements of Section 15010, Mechanical General Provisions.
- .3 The Balancing Agency is to be fully qualified and recognized firm having established a reputation with the Consultant for this type of Work. Members of AABC, NEBB or operating under the direction of a registered professional engineer will be considered.
- .4 Perform this Work in accordance with procedures and standards described in SMACNA "Balancing and Adjusting Manual".

1.2 Related Work Specified Elsewhere

.1	Pipe & Fittings:	Section 15050
.2	Air Distribution:	Section 15800
.3	Controls & Instrumentation:	Section 15900

1.3 Description of Work

- .1 Meet with Prime Mechanical Contractor to discuss location of all balancing and testing devices before construction starts.
- .2 Meet with Prime Mechanical Contractor on site to review work in progress. Minimum four times are required before balancing and testing commences.
- .3 Conduct preliminary water and air tests.
- .4 Test and balance water and air systems to design drawings and specifications.
- .5 Test and adjust mechanical equipment and controls.
- .6 Submit preliminary reports to the Consultant.
- .7 Conduct acceptance test on site with the Consultant.
- .8 Submit final report.
- .9 Meet with Section 15900 to review controls before construction is completed.

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- .10 Visit the project two (2) times after Substantial Completion letter from the Architect's office, to make adjustments to air and water distribution as required by the Consultant and the Owner's Representative.

1.4 Prime Mechanical Contractor Responsibility

- .1 Provide to the Testing Agency a Tender Set of mechanical drawings, Specifications, all Addenda and Change Orders, and shop drawings of all equipment to be tested and balanced.
- .2 Supply and install all balancing devices where required by the testing agency.
- .3 Provide to the testing agency a set of all approval drawings reviewed by the Consultant with wiring diagrams.
- .4 The respective trades shall provide a journeyman, tools, ladders and scaffolding to assist the Balancing and Testing Agency. He shall open and replace ceilings and install additional devices such as baffles, dampers, valves, etc., as required and requested. Sheave and belt changes to be supplied and installed by the Prime Mechanical Contractor as required by the Testing Agency. Pump impeller changes/modifications to be supplied and installed by the Prime Mechanical Contractor as required by the testing agency.
- .5 The Monitoring & Control System Section 15900 shall check all control operation before balancing and testing is started. Assist the Balancing and Testing Agency in final adjustment of air and water systems to provide comfortable space conditions.
- .6 The Prime Mechanical 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 or equipment, and shall bear all costs for liability, repairs and restoration in this connection.

1.5 Preliminary Tests

- .1 Prime Mechanical Contractor shall operate all the equipment for a minimum of five (5) days. Defects disclosed must be repaired and tests repeated until pronounced satisfactory by the Consultant. Lubricate all bearings; adjust and set all direct and V-belt drives for proper alignment and tension; calibrate and adjust all thermostats, thermometers linkage and dampers; operate and test all motors and speed switches for correct wiring sequences; check all overload heaters in motor starters; replace and clean all filters; flush out lines and equipment; remove and clean all strainer screens; fill all water systems and purge all air; clean the fan wheels, heating coils; fasten all loose and rattling pieces of equipment.
- .2 The Testing Company shall operate and test all systems in the wide open position. Check all control valves, dampers and regulators for proper operation. Report any defects to Division 15 for adjustment.
- .3 Vary the loads to illustrate start-up, sequence, normal shutdown, and simulate emergency conditions for safety shutdowns, with automatic and manual reset.

1.6 Water Systems

- .1 Adjust and balance the water circulating systems to provide temperature change and pressure drop to design.
- .2 Adjust and balance each fan coil, radiation, and cabinet heater using balancing valves to provide temperature change and pressure drop to design.

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- .3 Assist the Temperature Controls Contractor to check and adjust the temperature control system for proper sequence of operation.
- .4 Check and adjust the expansion tanks, regulating and safety relief valves for proper setting.
- .5 Test and record all inlet and outlet temperatures and pressures, pump RPM, Voltage and Amperage draw.
- .6 Assist Temperature Controls Contractor with setting up existing VFD drives for existing heating and cooling system pumps.

1.7 Air Systems

- .1 Balance and adjust all supply, exhaust and return systems using manometers, tachometers, thermometers, electronic flowhood, volt/ammeter as required. System volumes shall be within 5% of specified requirements for low velocity systems.
- .2 Adjust and set duct branch dampers to each grille to obtain air quantities shown on the drawings. Final 10% adjustment to be made with grille or diffuser damper. Excessive air noise at the outlet will not be accepted.
- .3 Set fan drives to provide air quantities and pressure specified. Sheave and belt changes to be supplied and installed by Division 15.
- .4 Test and adjust air flow through coils, plenums, and filters. Record temperature change and pressure drop.

1.8 Final Tests

- .1 The Testing Agency shall conduct final tests in the presence of the Consultant or his representative. Provide advance notice, in writing, that the preliminary tests have been completed and that final tests are ready.
- .2 Conduct test to demonstrate that the plant actually meets the specified requirements.

1.9 Reports

- .1 Submit preliminary testing report upon completion of the water and air systems before final tests.
- .2 Report shall include project names, date of test, name of testing technicians, diagram of each system.
- .3 **Water Circulating Systems:** Record each pump RPM, HP, Voltage, motor current draw, GPM, head, and temperature change and pressure drop across each fan coil, heat exchanger and boiler.
- .4 **Air Systems:** Record each fan RPM, HP, Voltage, operating current draw, total air quantities at each fan, grille and diffuser. Record velocity and pressure drop across each coil and filter bank. Record air temperature change across each coil.
- .5 **Final Report:** After final tests in the presence of the Consultant or his representative, the reports shall be updated to reflect final adjustments.
- .6 Submit three (3) copies of the final balancing and testing report to the Consultant for review before final payment is made.

**ST. ALOYSIUS CATHOLIC ELEMENTARY SCHOOL - ADDITION
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1.10 Adjustments

- .1 The Balancing and Testing Agency shall return three (3) times during the first year guarantee period to make adjustments to water and air systems as required to provide comfort to the occupants.

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MECHANICAL

Basic Materials & Methods

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Section 15050
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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.

1.2 Related Work Specified Elsewhere

.1	Painting	Section 09900
.2	Insulation	Section 15180
.3	Plumbing	Section 15400
.4	Plumbing Fixtures & Trim	Section 15401
.5	Sprinklers System	Section 15510
.6	Standpipe System	Section 15530
.7	Fire Extinguishers	Section 15540
.8	Liquid Heat Transfer	Section 15700
.9	Air Distribution	Section 15800
.10	Controls & Instrumentation	Section 15900
.11	Refrigeration	Section 15950
.12	Electrical	Division 16

1.3 Quality Assurance

- .1 Conform the latest edition, including Amendments of the following Codes and Standards.
- .2 Local and district by-laws, regulations and published engineering standards.
- .3 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 332/12 including all amendments.
- .4 ACNBC Canadian Plumbing Code.
- .5 Regulations for Construction Project, Ontario Regulation 659 under the Occupational Health and Safety Act.
- .6 Natural Gas Installation Code CSA-B149
- .7 All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- .8 All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

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Basic Materials & Methods

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PART 2 - PRODUCTS

2.1 Pipe & Pipe Fittings

.1 Heating Piping:

- .1 Steel pipe 2" (50 mm) and smaller: Schedule 40, electric weld or seamless ASTM Specification A-53.
- .2 Steel pipe 2-1/2" (65 mm) and larger: Schedule 40, electric weld or seamless ASTM Specification A-53 with butt welding ends.
- .3 Copper pipe 3/4" (19 mm) and smaller: Type "L" hard drawn copper with wrought copper solder type fittings to ASTM B88-03.
- .4 Dielectric unions to be used between copper and steel pipe.
- .5 Steel pipe fittings up to and including 2" (50 mm) are to be threaded joints malleable iron type.
- .6 Steel pipe fittings 2-1/2" (65 mm) and larger are to be forged steel butt welding type with all joints welded.
- .7 Grooved Mechanical Joints:
 - .1 1-1/2" (40 mm) pipe and larger to be standard steel pipe. Light wall pipe is not acceptable.
 - .2 The grooves and gaskets must be installed according to Manufacturer's installation instructions. The groove must be clean and true. The gasket seat pipe surface must be free of indentations, roll marks and projections.
 - .3 The gaskets shall be standard Grade EHP -30°F (-34°C) to 250°F (120°C) or Grade E -30°F (-34°C) to 230°F (110°C) and 300 psig (2065 kPa). Gaskets shall be suitable for use with 40% ethylene glycol or of a grade suitable for the intended service.
 - .4 The couplings shall consist of two ductile iron housing segments and be a combination of rigid joints in risers, Mechanical Rooms, and where flexibility is not desired; and flexible couplings for controlled pipe movement and flex-connector elimination.
 - .1 Rigid Type: Housings shall be cast with torque absorber and shift limiting offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9, and to prevent mis-assembly due to overshift. Housings cast with alignment indicator notch for visual proper alignment to adjoining fitting. Installation-Ready, for direct stab installation without field disassembly, with grade EHP gasket rated to +250 deg F / 120 deg C. Victaulic Style 107V.
 - .2 Flexible Type: Victaulic Installation-Ready Style 177N or Style 77 and Style 75.
 - .3 14" (350 mm) through 24" (600 mm): Victaulic AGS series with lead-in chamfer on housing key and wide width FlushSeal® gasket.
 - .1 Rigid Type: Housing key shall fill the wedge shaped AGS groove and provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style W07.

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- .2 Flexible Type: Housing key shall fit into the wedge shaped AGS groove and allow for linear and angular pipe movement. Victaulic Style W77.
 - .5 Valves and Fittings - Grooved end fittings, grooved end valves, and specialties may be used as part of the mechanical joint system.
 - .1 Fittings shall be cast of ductile iron to ASTM A536, wrought steel to ASTM A234, or factory fabricated from steel pipe to ASTM A53.
 - .2 QuickVic 2" through 12" (50 mm through 300 mm); ASTM A536 Grade 65-45-12 ductile iron with Victaulic Original Grooved System (OGS) grooved ends, stiffening ribs, and alignment indicators, orange coated or hot dipped galvanized as per ASTM A123, working pressure 400-psi (2758-kPa). Victaulic QuickVic™ V10 (90-deg), V11 (45-deg), and V20 (tee).
 - .8 All elbows are to be long radius type.
 - .9 Copper pipe fittings to be cast copper alloy solder joint pressure fittings to ANSI B16.18-2001 or wrought copper and copper alloy solder joint pressure fittings to ANSI/ASME B16.22-2001.
 - .10 Design based on Victaulic
 - .11 Acceptable Products:
 - .1 Victaulic
 - .2 Shurjoint
 - .3 Grinnell
- .2 **Sanitary Drain, Storm and Vents:**
 - .1 Soil and waste pipe 3" (75 mm) and over to be medium weight cast iron type MJ, unless indicated otherwise; 2-1/2" (65 mm) and under copper DWV pipe and fittings when above floor and Type L copper when buried.
 - .2 Vent pipe 3" (75 mm) and up is to be medium weight cast iron type MJ; 2-1/2" (65 mm) and under galvanized steel pipe with cast iron drainage fittings or copper type DWV.
 - .3 Below grade piping only:
 - .1 ABS piping in accordance with CAN/CSA-B181.1-02 for 4" (100 mm) pipe sizes and smaller.
 - .2 PVC gravity sewer piping SDR28 for 6" (150 mm) pipe sizes and smaller to CAN/CSA-B182.1-02.
 - .3 PVC gravity sewer piping SDR35 for 8" (200 mm) pipe sizes and above to CAN/CSA-B182.2-02.
- .3 **Domestic Water Piping and Cold Condensate Piping:**
 - .1 Domestic water lines (cold, hot and re-circulating) above grade shall be type L Copper to ASTM B88-03.
 - .2 Domestic water lines (cold, hot and re-circulating) below grade shall be type K Copper to ASTM B88-03.
 - .3 Exposed piping in finished areas shall be chrome plated unless noted otherwise.
 - .4 As an option to copper tube and fittings, approved Schedule 10S stainless steel pipe may be used with grooved end stainless steel fittings.
 - .5 Air conditioning condensate lines above grade to be Type M copper to ASTM B88

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.4 Fittings:

- .1 Solder end wrought copper. As an option, tee fittings may be eliminated by using the T-Drill system for branches 1/2" to 2" (15 mm to 50 mm) for maximum run pipe diameter to 4" (100 mm). All joints must be brazed to Copper Development Association Handbook Specifications using B-cup series filler metal. Soft solder joints are not permitted.
- .2 Brass or bronze pipe flanges and flange fittings shall conform to ANSI B16.24.
- .3 Grooved Mechanical Joints:
 - .1 Fittings: ASME B16.22 wrought copper or ASME B16.18 cast bronze, manufactured to copper tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.) Victaulic Copper Connection.
 - .2 Fittings: type 304/304L or 316/316L stainless steel, conforming to ASTM A-403, WPS, WPS/S9, or CR/S9, or shall be factory-manufactured from stainless steel pipe conforming to ASTM A312. Standard of Acceptance: Victaulic Company.
 - .3 The gaskets shall be Grade P Fluoroelastomer, center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth. Approved for potable water service to +180 deg F / + 82 deg C.
 - .4 Couplings for copper tube shall consist of two ductile iron housing segments cast with offsetting angle-pattern bolt pads. Installation-Ready, for direct stab installation without field disassembly. Victaulic Style 607.
 - .5 Couplings for stainless steel pipe: Coupling housings with blue enamel coating with Grade P Fluoroelastomer centre-leg gasket. Standard of acceptance: Victaulic Style 807N (rigid) and 877N (flexible).
 - .6 UL classified in accordance with NSF-61 for potable water service, and meets the lead content requirements of NSF-372.

2.2 Hangers & Supports

- .1 Hangers shall be carbon steel with copper or plastic coating for direct support of copper tubing, and shall be carbon steel with black corrosion resistant finish for all other piping.
- .2 Use Anvil Fig. 65, 69, 97, CT-99, 260, or 269 hangers for individual support of all horizontal piping.
- .3 Provide Anvil Fig. 168 pipe covering protection saddles at each hanger where pipes are insulated.
- .4 Provide Anvil Fig. 171 single pipe rollers complete with Fig. 160 protection saddles on all heating mains where identified.
- .5 Clevis hangers shall outside pipe insulation.
- .6 All hanger rods shall be rust resistant galvanized dipped.
- .7 All vertical piping shall be supported at each floor with riser clamps, Anvil Fig. 261 welded to the pipe. Vertical branch piping shall be supported at least every 10' 0" (3000 mm) with solid post ring hangers.
- .8 Use 4" x 1-1/2" (100 mm x 40 mm) minimum steel channel for joint support of horizontal piping.

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- .9 Use welded beam attachments or beam clamps for support of horizontal pipe from steelwork. DO NOT SUPPORT FROM METAL DECK.
- .10 Perforated pipe hangers are not acceptable.
- .11 Determine spacing between pipe rack supports using smallest pipe size.
- .12 Provide Anvil Fig. 262 pipe saddles on each pipe where trapeze hangers are used.
- .13 Hangers supporting plastic pipes shall be complete with a galvanized "V" bottom equal to Taylor Pipe Supports Model 12V V-Channel.
- .14 Acceptable Products:
 - .1 Anvil
 - .2 Myatt
 - .3 Economec

2.3 Valves & Accessories

- .1 **Domestic Water:** UL classified in accordance with NSF-61 for potable water service, and meets the lead content requirements of NSF-372.
 - .1 Ball:
 - .1 1/2" to 2-1/2" (15 mm to 65 mm) brass or bronze body, full port, TFE seats, double O-ring design or TFE packing, chrome plated solid bronze ball, lever handle.
Acceptable Products:
 - .1 ITT
 - .2 Victaulic
 - .3 Kitz
 - .4 Toyo
 - .5 Apollo
 - .2 Butterfly:
 - .1 3" to 12" (50 mm to 300 mm) wafer type, iron or ductile iron body, type 416 stainless steel stem, replaceable Buna 'N' seat, aluminum bronze disc and suitable for mounting between ANSI 125 or 150 flanges.
Acceptable Products:
 - .1 Crane
 - .2 Milwaukee
 - .3 Bray
 - .4 Kitz
 - .2 2-1/2" to 6" (65 mm - 150 mm), with copper tubing sized grooved ends. Cast brass body to UNS C87850, aluminum bronze disc to UNS C95500, with pressure responsive elastomer seat. Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating. Suitable for working pressure to 300 psi CWP. Victaulic Series 608N.
 - .3 Stainless Steel Pipe: stainless steel body with grooved ends, stainless steel disc, pressure-responsive Fluoroelastomer seat, with stainless steel stem. Stem shall be offset from the disc centreline to provide complete 360-degree circumferential seating. Bubble-tight, dead-end service, with memory stop for throttling. Victaulic Series 861.

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- .3 Gate:
 - .1 1/2" to 2" (15 mm to 50 mm) bronze body, solder ends, solid wedge disc and non-rising stem.
Acceptable Products:
 - .1 Crane 300 psi (2068 kPa)
 - .2 Milwaukee
 - .3 Bray
 - .4 Kitz
 - .5 Toyo
 - .2 2-1/2" to 8" (65 mm to 200 mm) iron body, flanged O.S. & Y. gate valve with bronze trim.
Acceptable Products:
 - .1 Crane 200 psi (1379 kPa)
 - .2 Milwaukee
 - .3 Bray
 - .4 Kitz
- .4 Globe:
 - .1 1/2" to 2" (15 mm to 50 mm) bronze body, solder ends and Teflon disc.
Acceptable Products:
 - .1 Crane 300 psi (2068 kPa)
 - .2 Milwaukee
 - .3 Kitz
 - .2 2-1/2" to 8" (65 mm to 200 mm) iron body, flanged and bronze trim.
Acceptable Products:
 - .1 Crane 200 psi (1379 kPa)
 - .2 Milwaukee
 - .3 Kitz
- .5 Check:
 - .1 1/2" to 3" (15 mm to 80 mm) steam bronze, swing check valve and 'Y' pattern.
Acceptable Products:
 - .1 Crane 300 psi (2068 kPa) (solder), (screwed)
 - .2 Milwaukee (solder); (screwed)
 - .3 Kitz
 - .4 Toyo
 - .2 2" to 12": 300 psi (2065 kPa CWP), grooved end Grade CF8M stainless steel body and disc, 17-4PH stainless steel shaft, with 17-4PH or 316 stainless steel spring, and Grade P Fluoroelastomer seat. Suitable for vertical or horizontal installation. Victaulic Series 816.
- .6 Valve installed in domestic hot water recirculation pipe system shall be equal to Griswold Controls Speed Set or Victaulic Series 790 manual balance valve complete with a memory stop or Victaulic Series 76X ICSS (Internal Cartridge Stainless Steel) flow-limiting valve or TA Therm-Zero Temperature-limiting valve.
- .7 Strainers:
 - .1 1/2" to 3" (15 mm to 80 mm) bronze body, stainless steel screen type 304 and .125" (3.2 mm) perforations.
Acceptable Products:
 - .1 Sarco
 - .2 Watts
 - .3 Colton

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- .4 Mueller
 - .5 SureFlow
 - .6 Victaulic / Bermad Series 968-F
 - .8 Thermoplastic Valves:
 - .1 Ball: Aqua Rise ball valves of sizes 1/2" to 2" (15 mm to 50 mm) shall be union style made from CPVC fitting compound. For Size 2-1/2" (65 mm) ball valve shall be IPEX-VKD-CPVC rated for 232 psi (1600 kPa) at 73°F (23°C).
- .2 **Heating:**
 - .1 All insulated valves shall have extended necks or shafts where the thickness of the insulation interferes with the operating handle.
 - .2 Ball:
 - .1 1/2" to 2" (15 mm to 50 mm) 150 psig/600HOG, full port, bronze body, bronze fitted screwed ends, PTFE seats and packing to 400°F (204°C), lever handle.
Acceptable Products:
 - .1 Sure Flow
 - .2 Milwaukee
 - .3 Victaulic
 - .4 Kitz
 - .5 Toyo
 - .3 Butterfly:
 - .1 2-1/2" (65 mm) and larger 200 psi, ductile iron, wafer type body for ANSI 150 flanges, bronze disc, stainless steel shaft, EPDM seat. Lug pattern body shall be used for dead-end or isolation service. Lever handle up to 4" (100 mm), gear operator 6" (150 mm) and larger.
Acceptable Products:
 - .1 Crane/Jenkins
 - .2 Kitz
 - .3 Sure Flow
 - .4 Bray
 - .5 Keystone
 - .6 Milwaukee
 - .2 2" to 24" (50 mm to 600 mm) grooved ends, ductile iron body, stainless steel stem with elastomer seat, pressure responsive in sizes through 12", disc mounted for 14" and larger. (Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.)
 - .1 Victaulic Vic300 MasterSeal and AGS Vic300.
 - .4 Check:
 - .1 1/2" to 2-1/2" (15 mm to 65 mm) Class 125 bronze body, screwed ends, swing disc, screw-in cap.
Acceptable Products:
 - .1 Crane/Jenkins
 - .2 Grinnell
 - .3 Milwaukee
 - .4 Sure Flow
 - .5 Kitz

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- .2 3" (80 mm) and larger wafer-type ANSI 125 CI body, stainless steel disc, stainless hinge and shaft, Viton seat.
Acceptable Products:
 - .1 Proquip
 - .2 RitePro Inc.
 - .3 Moygro
 - .4 Crane
 - .5 Sure Flow
 - .6 Kitz
- .3 2" to 24" (50 mm to 600 mm): Grooved end ductile iron body, with stainless steel spring, suitable for vertical installation.
 - .1 Stainless steel disc with elastomer seat / seal.
 - .2 Elastomer coated ductile iron disc with welded-in nickel seat.
 - .3 Victaulic Series 716 and AGS W715.
- .5 Strainers:
 - .1 1/2" to 2" (15 mm to 50 mm) cast iron 'Y' body pattern, screwed ends and cap with brass plug, stainless steel screen with 0.125 perforations for water service.
Acceptable Products:
 - .1 Sarco
 - .2 ITT
 - .3 Mueller
 - .4 Kitz
 - .5 Sure Flow
 - .2 2-1/2" (65 mm) and larger cast iron 'Y' body, flanged ends and cap with full plug size ball valve blow-off, stainless steel screen with full plug size ball valve blow-off, stainless steel screen with 0.125" (3.2 mm) perforations for water services.
Acceptable Products:
 - .1 Sarco
 - .2 Mueller
 - .3 Gruvlok
 - .3 2" to 18" (50 mm to 450 mm), grooved end "Y" pattern ductile iron body with coupled cover for strainer maintenance, stainless steel perforated metal basket, rated for working pressure to 300 psig CWP.
 - .1 Victaulic Style 732 and AGS W732.
 - .4 Factory Assembled Pump Drops:
 - .1 Manufactured Vibration Isolation Pump Drops for sizes 3" through 12": Installation-Ready with grooved joints, orange enamel coating, with flexible couplings to accommodate vibration attenuation and stress relief, and pipe spool with thermometer and pressure ports. Assembly rated for working pressure to 300-psig. Victaulic Suction Pump Drop Series 381, Victaulic Discharge Pump Drop Series 380.
- .6 All Radiators, Convectors and Coil-type Heating Units:
 - .1 1/2" to 1-1/4" (15 mm to 32 mm) Dahl Model No. 11042.

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2.4 Reduced Pressure Principle Backflow Preventer

- .1 Shall consist of a differential pressure relief valve located between two in line cartridges in a bronze body that has four upward facing test cocks and full ported inlet and outlet ball valve shut offs with union connections between the valves and the cartridge. There shall be a single access cover for servicing both check valves with a separate access cover for servicing the relief valve. Maximum emergency backflow temperature 248°F (120°C) and maximum pressure 175 psig (1200 kPa). Device shall be certified in compliance with CAN/CSA B64.4 and complete with air gap drain.
- .2 Acceptable Products:
 - .1 Zurn Wilkins 975 XLU
 - .2 Watts Series 909QT
 - .3 Febco Model 860

2.5 Fire Stopping

- .1 The Prime Mechanical Contractor is responsible for all fire stopping related to the Work of Division 15 including, but not limited to, the ductwork, piping and control wiring. Fire stopping shall be in accordance with Architectural Specifications.
- .2 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases.
- .3 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.
- .4 Systems to have an F rating not less than the fire protection rating required for closures in a fire separation.
- .5 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.
- .6 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- .7 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes.
- .8 Acceptable Products:
 - .1 Fyresleeve Industries Inc.
 - .2 General Electric Pensil Firestop Systems
 - .3 International Protective Coatings Corp.
 - .4 Rectorseal Corporation (Metacaulk)
 - .5 3M Fire Protection Systems

2.6 Double Check Valve Assembly Backflow Preventer

- .1 Shall consist of two independently acting swing check valves located in a ductile iron body that has an internal and external fusion epoxy coating. The assembly shall be complete with inlet and outlet full ported (NRS or OS&Y) resilient seated shut off valves with four resilient seated test cocks. The main body shall be two piece design, joined with a grooved coupling. Device shall be certified in compliance with CAN/CSA B64.5.

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- .2 Acceptable Products:
 - .1 Zurn Wilkins 950XL
 - .2 Watts Series 709
 - .3 Febco Model 850

2.7 Backflow Preventer - DESIGNATED BFP

- .1 Supply and install backflow preventer where shown on the Drawings and where required by Code on potable water connections to equipment. Supply and install for each backflow assembly, a by-pass assembly complete with isolation valve and pipe, size equal to assembly.
- .2 Valve shall be complete with bronze body, check seals, stainless steel trim, durable tight-seating rubber discs and bronze valve test cocks.
- .3 Severe hazard connections such as trap seal primer shall have an air gap "AG".
- .4 Minor hazard connections such as hose bibbs and flexible shower heads, shall have atmosphere vacuum breaker "AVB".
- .5 Moderate hazard connections such as vending machines and ice making machines, shall have pressure vacuum breaker "PVB".
- .6 Acceptable Products:
 - .1 Watts
 - .2 Apollo
 - .3 Zurn Williams

2.8 Escutcheons

- .1 Supply and install 1-piece chromium plated escutcheon plates on all piping passing through finished walls, floors and ceilings. Where sleeves project above the floor in potentially wet areas, Provide chromium plated box type escutcheon.
- .2 Escutcheon plates shall be installed over the insulation and shall have set screws or clamping devices to keep the escutcheon plate in place.
- .3 Acceptable Products:
 - .1 Watts
 - .2 Fire Sprinkler Products and Accessories, Stoney Creek

2.9 Roof Flashings

- .1 Roof flashings for conduit and refrigeration piping serving the air cooled condensing units shall be copper, 450 mm (18") high, pre-insulated with E.P.D.M. grommets for multiple penetrations, compatible with E.P.D.M. roof membrane, as manufactured by Thaler Metal Industries, Model No. MEF-AG4-6.
- .2 Roof flashings for conduit serving outdoor fan units shall be copper, 450 mm (18") high, pre-insulated with E.P.D.M. grommets for multiple penetrations, compatible with E.P.D.M. roof membrane, as manufactured by Thaler Metal Industries, Model No. MEF-AG2-3.

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2.10 Building Sewer Backflow Valve - DESIGNATED BFV

- .1 Supply and install a backflow valve in building sewer pipe, inside the building.
- .2 Valve to be complete with the following:
 - .1 Prefabricated access box complete with cover plate.
 - .2 Clear top
 - .3 Full port
 - .4 Cleanout
 - .5 Gate complete with floats
- .3 Design based in Mainline Backflow Products, Straight-Fit.
- .4 Provide for both Sanitary and Storm Sewers

2.11 Make-Up Water Feeders

- .1 Install a Mueller, Watts or Armstrong 3/4" (20 mm) pressure reducing valve only (no relief), with compression stop valve and strainer set at pressures indicated on the Drawings (Mueller Model C-15400).
- .2 Install on all cold water make-up feeders to mechanical equipment, an approved backflow preventer. See Backflow Preventer above.

PART 3 - EXECUTION

3.1 Piping Installation

- .1 **Heating Piping:**
 - .1 Make all piping connections to boiler, radiation, coils, fan coil units, etc. Unions and valves to be located so that removal of units and equipment is possible without disconnecting more than a minimum of pipework, and without shutting down any other pieces of equipment.
 - .2 Where branch pipes are welded into mains without the use of "T" connections, torch cut openings must be cut true, bevelled and filed smooth. Branch pipes must not be allowed to project inside of main pipe. Openings must not be cut large enough to permit entry of welding metal and slag within the pipe.
 - .3 Grade horizontal water distribution piping 1" per 30 ft. (2.78 mm per meter) rising in direction of flow, wherever possible. Provide ball valves with cap and chain for draining at all low points and vent valves at high points of systems.
 - .4 Provide adequate space around piping to facilitate application of insulation.
 - .5 All reductions in pipe size to be made with eccentric fittings. Minimum size of run out shall be 3/4" (19 mm).
 - .6 Install piping to clear other piping, lights, obstructions, access doors and controls. Take branches off mains with fittings and 45° or 90° elbows. Locate valves and special devices for easy operation. Locate valves in accessible locations to approval and to suit access.
 - .7 Do not use ferrous piping, fittings, bushings, nipples or plugs in copper piping.
 - .8 Make reductions in hot water heating system piping so that air cannot collect in piping except at air vents.
 - .9 Install systems so that they can be thoroughly drained and all air eliminated.

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- .10 During welding or soldering procedures, Provide a fire retardant cloth, mat or blanket to protect the structure, and adequate fire protection equipment at all locations where Work is being done. Close off shaft or confined areas with a fire retardant mat or cloth to prevent sparks or pieces of hot metal from falling down the shaft or area way.
- .11 Plug and/or cap all pipe openings/fittings during construction.
- .12 DO NOT USE copper pipe connections between runtal heating units and steel pipe.
- .2 **Sanitary, Storm and Vent Piping:**
 - .1 Install sanitary drains and connect to fixtures where shown. Connect up all drains to drain, open hub or other approved locations. Connect to drainage system all drains from equipment supplied under other Sections.
 - .2 Horizontal sanitary drains shall have the following minimum slopes:
 - .1 Fixture waste or drains 1/4" per ft. (20 mm per meter)
 - .2 Drains up to and including 3" (75 mm) 1/4" per ft. (20 mm per meter)
 - .3 Drains over 3" (75 mm) 1/8" per ft. (10 mm per meter)
 - .3 Connect storm drains to all roof hoppers, specialty gutter outlets, etc. Carry main drain to a point as shown on Drawings.
 - .4 All fixtures are to be vented in accordance with Local and Provincial Regulations. Vents are to be run as directly as possible and to be properly graded so as to drain back to fixture connection. Vents are to be concealed in walls, and ceilings; vent stacks are to be built into pipe chases, concealed areas, and walls, with particular attention paid to building frame construction.
 - .5 Vent stacks are to be connected to the vent extensions Provided by Division 7 and installed by the General Contractor. The only exposed vent pipe or vent stack allowed will be in the areas provided in pipe spaces, mechanical room, etc. Maintain a minimum of 10'-0" (3000 mm) from outside air intakes to location of vent stack.
 - .6 Connect vent lines to soil and vent stacks above highest fixture or separately carry through roof. End vent stacks and vent piping 16" (400 mm) above roof or to vent flashing.
 - .7 Science room vent pipes to be borosilicate glass, terminate in ceiling space below roof deck and extend through roof to 16" (400 mm) above roof or to vent flashing.
 - .8 Supply and install a cleanout at each sanitary and/or storm pipe change of direction.
- .3 **Domestic Water Piping and Cold Condensate Piping:**
 - .1 Connect cold water to all fixtures, hose bibs, as required and as shown. This is to include all connections to equipment and units supplied under other Sections.
 - .2 All equipment is to have unions or flanged connection for equipment removal, and where possible piping is to run concealed in all walls and ceiling, but may run exposed in mechanical rooms and warehouse.
 - .3 Install shock absorbers ahead of all solenoid valves, flush valves or other quick closing valves and where shown. Vacuum breakers are to be installed on all fixtures where required by the Ontario Plumbing Code, or Local Plumbing Inspector.

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- .4 Connect condensate piping to all drain pans and run to nearest drain.
- .5 Where it is necessary to offset piping to avoid obstructions, only use 45 degree elbows, NOT 90 degree elbows.
- .4 **Gas Piping:**
 - .1 Schedule 40:
 - .1 Complete installation to conform to the latest edition of the gas code including the colour coding of the pipe which is to be by the Contractor and to the satisfaction of the Consultant.
 - .2 Slope the piping towards low points or risers, low point drips to have tee, nipple and cap.
 - .3 Use soap solution and compressed air to test all joints and fittings for leakage. Repair as required.
- .5 **Chemical Resistant Drainage Piping:** Connect drainage piping to plumbing fixtures and chemical neutralizing systems where noted on Drawings.
- .6 **Equipment Connection:** Install unions and/or flanges to connect piping to all pieces of equipment. All equipment is to have isolating valves for equipment removal.
- .7 **Flashing:** All vent stacks and soil stacks are to connect to insulated stack vents. Stack vents are supplied and installed through the roof by Division 7. All holes through roof are to be properly flashed and made weatherproof by roofer as required under Division 7.
- .8 **Thermal Expansion and Contraction of Piping:**
 - .1 The Contractor to be responsible for expansion and contraction of all pipework. Erect all pipe in such a manner that the strain and weight does not come upon pipe connections of apparatus. Provide bends, or swing joints except where corrugated bellows type expansion joints are shown or required.
 - .2 On steel piping up to 2" (50 mm) size, use stainless steel bellows, screwed, compensator type, 150 lb (1035 Pa) design (similar for brass or copper pipe, except all-bronze construction).
 - .3 Piping 2-1/2" (65 mm) and larger 150 lb (1035 kPa) flanged, self-equalizing, corrugated packless, stainless steel bellows, tie rods, or Victaulic Flexible Couplings as shown on drawings.
 - .4 Select for expansion between anchor points plus 25% safety factor with 0°F (-18°C) ambient temperature and applicable fluid temperature.
 - .5 Flexible hose, where called for, shall be Type 'RW'.
 - .6 In wall fin, all runs over 40'-0" (12000 mm) shall have Flexonics Type 'L' in middle of run.
 - .7 Pipe anchors and guides shall be fabricated of structural steel channels, angles or plates well secured to the building structure. Cylindrical type guides to be sized for full pipe insulation.
 - .8 Acceptable Products:
 - .1 Flexonics
 - .2 Adesco
 - .3 United Flexible
 - .4 Victaulic Style 155/155P compensators or Expansion Loops.

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- .9 **Air Elimination and Drainage:** All low points to be installed with a ball valve with a screwed connection suitable for connecting a hose. Install air vents at all high points in system.

3.2 Piping Joints

.1 Threaded Joints:

- .1 Pipe is to be cut at right angles and reamed to full bore.
- .2 Threads are to be carefully cut with sharp dies and proper cutting oil.
- .3 All chips and other foreign matter are to be removed from the pipe before installation into system.
- .4 Proper joint compound is to be used on male threads only. A good grade of hemp fibre is to be used on threads.
- .5 Connections to be made with proper wrench to suit pipe size, additional leverage not to be allowed.
- .6 If threaded joints leak after assembly by normal methods, they are to be disconnected and corrected if possible, or replaced. Over tightening or caulking is not considered a proper correction.

.2 Solder Joints:

- .1 Pipe is to be cut at right angles, reamed, de-burred and sized.
- .2 End of pipe and inside of fittings to be cleaned with steel wool to a bright metallic finish.
- .3 Flux to be applied to outside of pipe and inside of fittings; fitting to be revolved on pipe to ensure proper distribution of flux.
- .4 Using solder wire, heat assembly with torch until solder has flowed completely around fittings. Wipe off excess solder. Solder used on potable water systems to consist of 0.2% maximum lead composition or alternatively use 90/5/5 tin/silver/antimony. Larger size pipe joints are to be completely tinned before assembly.

.3 Cast Iron Joints:

- .1 Mechanical joint cast iron piping and fittings will be assembled in accordance with Manufacturer's recommendations.

.4 PVC, Polypropylene and ABS Piping Joints:

- .1 Install PVC, Polypropylene and ABS joints as per Manufacturer's recommendations, using approved joining methods, compounds and materials.

.5 Mechanical Couplings:

- .1 Couplings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12.
- .2 Grooved joints shall be installed in accordance with the manufacturer's latest published instructions.
- .3 The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer.
- .4 Installing Contractor to obtain on-site and off-site installation training from the coupling manufacturer and inform Consultant in writing that the training is complete.

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- .5 The manufacturer's factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.
- .6 Installing Contractor to complete manufacturer "Inspection Form" and forward to the Consultant for review.

3.3 Firestopping

- .1 Confirm location and extent of fire separations from Architectural Drawings.
- .2 Inspect surface to be firestopped. Report unsatisfactory conditions to Consultant in writing prior to commencement. Initiation of Work to be deemed as acceptance of conditions and surfaces.
- .3 Store all materials in accordance with Manufacturers recommendations as to acceptable ambient temperatures. Damaged or deteriorated materials are not to be used and are to be removed from the site.
- .4 Install firestopping and smoke seal material and components in accordance with ULC certification and Manufacturers instructions in all piping, tubing, chimney and duct etc. penetrations in new or existing fire separation to provide temperature, flame and smoke rated seals not less than the fire resistance rating of the assembly, or separation.
- .5 Seal all holes made by through-penetrations and unpenetrated openings to ensure continuity and integrating of fire separation, including where existing component or device has been removed.
- .6 Notify Consultant and/or Authority having jurisdiction for inspection prior to concealing or enclosing fire stopping materials and service penetrations.
- .7 Remove excess material and debris and clean adjacent surfaces immediately after application. Leave in a tidy condition.

3.4 Welded Joints

- .1 Where the location of butt welded piping joints is left to the discretion of this Division, such joints shall be minimum 3'-0" (900 mm) from other welded piping joints.
- .2 Joint areas shall be thoroughly cleaned to remove all slag, oil, grease, rust, scale and moisture prior to commencement of welding. Slag and spatter shall be removed completely from each welding pass before the next pass is deposited.

3.5 Butt Welding

- .1 Unless otherwise specified, all 2-1/2" (65 mm) size and larger piping shall be prepared for butt welding. Unless otherwise specified, butt welding and preparation shall be in accordance with figure 1(a) of ANSI Standard B16.25, for piping with wall thickness of 3/16" to 3/4" (5 mm to 19 mm) inclusive. V-bevel end profiles for all alloy steel piping shall be made by machining only. This Division shall ensure that the end preparation is truly circular and concentric with the pipe axis and within the tolerances allowed by applicable standards.
- .2 V-bevel end profiles for carbon steel piping shall be made by machining or flame cutting. This Division shall ensure that the end preparation is truly circular and concentric with the pipe axis and within the tolerances allowed by applicable standards.

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- .3 Where the flame cutting is employed on end preparation, the cut shall be thoroughly dressed afterwards to eliminate all scale, profile irregularities and to give clean, shiny surfaces.

3.6 Welding of Pressure Piping

- .1 **General:** Pressure welding shall conform to ANSI B.31.1, ASME Boiler and Pressure Vessel Code and the MCCR Boilers and Pressure Vessels Act.
- .2 **Welding Process:** Welding shall be done using either shielded metal-arc welding process and/or inert gas tungsten-arc welding process.
- .3 **Welding Procedures:**
 - .1 Welding procedures are to be submitted, registered and approved to requirements of MCCR Boiler and Pressure Vessels Act prior to submission to the Consultant for approval. The following limitations shall be observed in these procedures:
 - .2 Welders shall be tested and approved in accordance with Section IX of the ASME Boilers and Pressure Vessel Code and the requirements of the MCCR.
 - .3 No welding shall be performed when the ambient is less than 32°F (0°C). If the ambient is less than 32°F (0°C), a heated enclosure shall be required. When the base metal temperature is less than 50°F (10°C), the base metal shall be preheated to at least 70°F (21°C) and maintained at this temperature during welding and thereafter as required.
 - .4 The use of backing rings and strips shall not be permitted unless received prior approval of the Consultant. If their use is approved they shall be made from materials of weldable quality compatible with the base metal and shall be removed after welding unless the Consultant specifically approves their remaining in the joint.
 - .5 Where covered electrodes are used they shall be of the low hydrogen type and shall be properly conditioned prior to their use. Storage and handling practices shall be in accordance with the electrode Manufacturer's Specifications. Details of storage and handling practices shall be submitted by this Division when submitting welding procedures. Unless otherwise incorporated in the welding procedure, peening shall not be permitted.
- .4 **Performance of Welders:**
 - .1 No welding shall be undertaken prior to this Division supplying the Consultant valid certificates for this Division's personnel and procedures.
 - .2 Welds suspected to be defective shall be radiographed at no expense to the Owner.
 - .3 Weld defects shall be removed by grinding until the base metal is reached. Repairs shall be done using the same welding procedure as required for the original welds. Repaired welds shall be proven by radiograph at no expense to the Owner.
 - .4 If any three welds performed by the same welder require repair, the welder shall be disqualified from further welding.
 - .5 Welds shall be stamped with the welder's identification number.

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3.7 Flanged Joints

- .1 Flanges and other attachments shall be square with the indicated axis and shall not deviate from this position measured across any diameter by more than 3/64" per foot (4 mm per m.) of diameter. Maximum allowable dishing of a flange facing shall be 1/64" (0.4 mm).
- .2 Bolt holes shall be aligned within a tolerance of $\pm 1/16"$ (2 mm) of the required position.
- .3 Flanges shall be installed with the bolt holes straddling the vertical and horizontal centre lines or as required for proper valve position. Use box wrenches to pull up flanges.
- .4 Unless otherwise specified, lengths of studs shall be 1/4" (6 mm) longer than specified in ANSI B16.5.

3.8 Hangers & Supports

- .1 Horizontal piping is to be supported as close as practical to the connected equipment and intermediate hangers are to be spaced as follows:

Pipe Size	Single Rod Dia.	Double Rod Dia.	Maximum Spacing	
			Copper	Steel
Up to 3/4" (Up to 19 mm)	3/8" (10 mm)	3/8" (10 mm)	5'-0" (1500 mm)	6'-0" (1800 mm)
1" - 1-1/4" (25 mm to 32 mm)	3/8" (10 mm)	3/8" (10 mm)	5'-0" (1500 mm)	8'-0" (2400 mm)
1-1/2" - 2" (38 mm & 50 mm)	3/8" (10 mm)	3/8" (10 mm)	10'-0" (3000 mm)	10'-0" (3000 mm)
2-1/2" & 3" (65 mm & 75 mm)	1/2" (13 mm)	1/2" (13 mm)	10'-0" (3000 mm)	12'-0" (3700 mm)
4" (100 mm)	5/8" (16 mm)	5/8" (16 mm)	-	15'-0" ft. (4600 mm)
6" (150 mm)	3/4" (19 mm)	5/8" (16 mm)	-	17'-0" (5200 mm)

- .2 Cast Iron Piping is to be supported at intervals not exceeding 5'-0" (1500 mm) with clevis hanger securely anchored to building.
- .3 Cast Iron Fittings are to be supported at intervals not exceeding 3'-0" (900 mm).
- .4 Cast iron pipes are to be supported at every floor.
- .5 No support or hanger securing device is to penetrate waterproofing roof membrane above steel deck.
- .6 Provide roller supports, floor stands, wall brackets, etc. for all lines running near the floor or near the walls, which can be properly supported by the floors or walls.
- .7 All pipe support arrangements are to be adjustable for proper support and grading.
- .8 Suspend piping using malleable iron or wrought steel hangers suspended from hanger rods threaded each end not more than 1-1/2" (38 mm). Continuous threaded hanger rod is to be used in concealed locations only.

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- .9 Hanger rods are to be attached to concrete inserts, beam clamps, welded brackets or similar device. Co-ordinate location and method of pipe support in building with Structural Engineer.
- .10 Provide hangers for chilled water and cold water piping with the hanger around the insulation.
- .11 Thermoplastic piping hanger spacing to be at a minimum 4'-0" (1200 mm OC) or as per Manufacturers recommendations.
- .12 Steam and steam condensate piping shall be supported on roll hangers, Anvil Fig. 181, adjustable and complete with pipe covering protection saddle similar to Anvil Fig. 160 Series.

3.9 Backflow Preventers

- .1 All new backflow preventer installations must be tested, tagged, and the proper city or municipality form shall be filled out by the Contractor at time of installation, one copy will go to the city or municipality and one copy to the Owner.
- .2 The local authorities forms need to be properly filled out, providing the date of installation as well as all appropriate boxes checked on the form, determining initial or renewal testing.
- .3 This document is required for the initial installation and to provide a record so that proper yearly testing can be scheduled and completed on an annual basis as required by the Ontario Plumbing Code and the CAN/CSA B64.10-01 Manual for the Selection and Installation of Backflow Prevention Devices/ Manual for the Maintenance and Field Testing of Backflow Prevention Devices.
- .4 Where possible, installations of the device should be from a solid work area (floor or platform) to ensure testing and servicing is not from ladders.
- .5 All removals of existing backflow prevention devices must be reported in this manner.
- .6 Supply and install for each backflow preventer assembly, a by-pass assembly complete with isolation valves and pipe, size equal to assembly.

3.10 Inspection & Testing

- .1 Make tests that are required, by any authority having jurisdiction, in the presence of the Authority's Authorized Inspector. Tests are to be certified by him.
- .2 Test all piping at the completion of roughing-in before connecting to new systems, and prior to concealment, insulation or covering of piping.
- .3 Notify the Consultant in writing at least forty-eight (48) hours prior to start of tests. Failure to do so may require test to be re-done.
- .4 Ball test drains to Subsection 7.3.6.7 of the 2012 Ontario Building Code.
- .5 All new drainage and vent piping is to be tested using water test method before connection of fixtures and maintain the required water level for 24 hours. Pressure test science room and prep room piping in accordance with Manufacturer's instructions.
- .6 Do not pressure test with compressed air or gas.
- .7 Final air test drains, waste and vent piping to Part 7 of the Ontario Building Code (latest edition).

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- .8 Heating water piping to be tested by filling the system with water and applying a hydrostatic pressure of 125 psig (860 kPa) which is to be maintained for at least 24 hours. If a freezing hazard exists the Consultant may permit a compressed air test to be substituted.
- .9 Perform tests before application of pipe covering. Test buried and concealed piping before backfilling or concealing in structure. Protect equipment and parts not capable of withstanding test pressure during tests.
- .10 Any leaks found are to be properly repaired and test reapplied until results satisfactory to the Consultant are obtained.
- .11 Gas pipe joints and fittings to be checked with soap and water solution during air test. Disconnect system during tests. DO NOT USE OXYGEN FOR TESTING.
- .12 Test piping systems to the following pressures for four (4) hours without drop in pressure or as otherwise noted.
 - .1 Hot water heating: 150 psig (1035 kPa)
 - .2 Domestic water & Reverse Osmosis Water: Hydrostatically to 150 psig (1035 kPa) for one hour [OR] Air to 100 psig (690 kPa) for two hours
 - .3 Gas: Air to 50 psig (350 kPa) for twenty-four hours

3.11 Placing In Operation

- .1 Upon completion of the Work and before turning over the job, the Contractor is to make a complete test of the various systems.
- .2 Flush and sterilize domestic water mains in accordance with the procedures established by AWWA Specification C601.
- .3 Flush all other domestic water piping in accordance with Local and Provincial Codes.

3.12 Pipe Grading

- .1 Piping: Heating and chilled water piping is to run level. Domestic water piping is to grade to low points. Branch piping to heating units below the main shall be off the bottom, and off the top to units above.
- .2 Condensate piping to be graded down in direction of flow 1" in 20'-0" (25 mm in 6,000 mm).
- .3 Equipment drain piping to be graded down in the direction of flow 1" in 4'-0" (25 mm in 1,200 mm).

3.13 Venting

- .1 Vent fixtures and traps according to Ontario Building Code (Chapter 7) and local authorities regulations. Increase vents smaller than 3" (80 mm) diameter to 3" (80 mm) diameter before same passes through roof to outdoors.
- .2 Connect vent lines to soil and vent stacks above highest fixture or separately carry through roof to outdoors. End vent stacks and vent piping 16" (400 mm) above finished roof or to vent flashing.

3.14 Equipment Drains

- .1 Supply and install drain piping from all relief valves, and backflow preventers. Piping to be installed to spill into hub drains or funnel floor drains. Provide traps as required.

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3.15 Excavation, Trenching, Backfilling & Bedding (Indoors)

- .1 This Division shall do all excavation, trenching, backfilling and bedding in connection with this Work. Refer to the soil reports for details on rock relief, water table and soil material. Excavation is to be based on soil with random pieces up to 12" (300 mm) diameter. Foundations, large concrete pieces, slabs, rock layers and unstable soils that are not shown on the Drawings or soils reports will be treated as a site condition. Blasting is not permitted, except by permission of the Consultant. Rock material is to be broken by a hydraulic ram. All trenching and excavation shall be done in strict accordance with the Occupational Health and Safety Act latest revision thereof.
- .2 All excavations shall be protected with fencing, timber sheeting, bracing or shoring as required.
- .3 Remove all timber and protective devices before backfilling or when the necessity of protection ceases. Keep excavated areas free of water by providing pumps, hoses, strainer, other appurtenances, power, labour and maintenance as required. All piping and equipment shall be tested, inspected and approved before backfilling.
- .4 All piping and equipment shall have adequate bedding. Trenches shall be excavated 6" (150 mm) below the intended grade of the piping. The pipe bedding granular 'A' of which at least 50% will pass a 1/4" (8 mm) sieve and 100% will pass a 1/2" (15 mm) sieve, backfilled by hand from the centre line of the pipe to 6" (150 mm) above up to 18" (450 mm) diameter, and 12" (300 mm) above for larger diameter pipes. Compact in 6" (150 mm) layers by tamping. The subgrade beneath the pipe shall be within .03 ft. (9 mm) of a straight line between joints. Bell holes shall be made at each joint to permit the joint to be properly made. Debris is to be kept out of the piping. No backfill is permitted until the test is witnessed. Bedding shall be compacted to 95% modified Proctor test.
- .5 Backfill shall be non-cohesive ballast material of which at least 50% will pass a 1/4" (8 mm) sieve and 100% will pass a 1/2" (15 mm) sieve. The backfill shall be placed in layers not exceeding 12" (300 mm) loose measurement.
- .6 Compaction of the backfilled material shall be to 95% Proctor density. Where Proctor tests are called for, these will be paid for out of the allowance in Division 2. Proctor tests as a result of re-testing shall be paid for by this Division. Protect the pipe during backfilling and compaction so that damage or a movement of the pipe is avoided. The pipe must be protected with a minimum of 20" (500 mm) of compacted cover before backfill by mechanical means.
- .7 The backfill shall be compacted by mechanical hand compaction equipment to achieve the specified density. Water may be used as an aid to compaction, but not as the sole means of compaction. Backfilling shall not be done in freezing weather, except by permission of the Consultant.
- .8 Carefully backfill both sides of piping and equipment simultaneously to prevent movement or displacement. All excess materials shall be removed from the premises as directed and legally disposed of by this Division. In no case shall piping be installed over backfill. Special supports, bridges etc. are to be provided.

3.16 Drain Valves

- .1 Supply and install 3/4" (20 mm) ball valve and hose end at main low points to drain each water type system, at pumps, coils, strainers and at each piece of equipment.

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3.17 Dirt Accumulation Under All Valves

- .1 If dirt accumulates under the seat of valves (including automatic control valves) during the first years operation, remove the collected materials under the valve seats and if the seat is damaged, replace same at no additional cost to the Owner.

3.18 Affidavit

- .1 Submit an affidavit verifying to the use of non-lead bearing solder in all potable water copper piping system to the Consultant and insert in the Maintenance Manual.

3.19 Strainers

- .1 Locate strainers upstream of control valves, automatic balancing valves, pumps, etc., and where shown on Drawings.
- .2 Strainers shall be Provided with ball valves for blow down. Provide for the leaving side of the ball valve, nipples and fittings to permit blow down into a pail.
- .3 Sizes:
 - .1 3/4" to 1" (20 mm to 25 mm) - 1/2" (15 mm) ball valve
 - .2 1-1/4" to 2" (32 mm to 50 mm) - 1" (25 mm) ball valve
 - .3 2" (50 mm) and larger - 1-1/2" (40 mm) ball valve

3.20 Roof Flashings

- .1 Turn over flashings to the roofer for installation, Provide flashings for each roof penetration.
- .2 Provide a flashing for each air cooled condensing unit, 4 openings, one for power wiring conduit (by Division 16), one for control wiring conduit, one each for liquid and suction refrigerant piping.
- .3 Ensure that the flashing grommets are not cut or otherwise damaged during installation. Cut or damaged grommets must be replaced; caulking of the flashings to repair leaks will not be accepted.

3.21 Dielectric Couplings

- .1 Provide wherever pipes of dissimilar metals are joined.
- .2 Provide insulating unions for pipe sizes 2" (50 mm) diameter and smaller, and flanges for pipe sizes 2-1/2" (65 mm) diameter and larger. Brass adaptors and bronze valves will not be accepted.
- .3 Provide an isolating separation wherever piping may touch dissimilar metal studs, joists, concrete or other material.

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.

1.2 Related Work Specified Elsewhere

- .1 Basic Materials & Methods Section 15050

1.3 Submittals

- .1 Submit Shop Drawings in accordance with the Section 15011 for the following equipment:
 - .1 Chemicals
 - .2 Chemical Pot Feeders
 - .3 Chemical Filter

PART 2 - PRODUCTS

2.1 Pre-Operational Cleaning of New Heating Water Systems

- .1 Flush out piping systems after pressure test for a minimum of four (4) hours.
- .2 Fill and back flush hot water heating pipe and radiation to mains.
- .3 Fill and thoroughly flush new hot water heating pipe systems with a 1" (25 mm) diameter hose, every 100'-0" (30500 mm), connected to the domestic cold water system, complete with isolation valve and backflow preventer. Provide valved connections and all hoses. Upon completion of the flush out procedure, remove backflow preventer and cap pipe.
- .4 When declared clean by the Water Treatment Company, circulate cleaner equal to Dearborn No. 345 cleaner at a dosage of 100 lb/1000 gallon (45 kg/4500L) system water for a period of 72 hours. This is cold water cleaner and can be used at water temperatures 50°F to 150°F (10°C to 65°C).
- .5 At completion of a circulating period, system shall be drained and flushed with fresh water for a period of four (4) hours. Blow down drains of all duct mounted heat coils. Blow down drains at all system low points. The flushing of each low point shall be completed by flushing first with the supply valve open, return valve closed, and then the return valve open, supply valve closed. All strainers and filters shall be opened and cleaned. Chemical Treatment Company must approve flushing test at end of the cleaning period. Cleaning shall continue until system is accepted. Provide 24 hours advance notice.
- .6 Each system shall be filled with clean water to give 7.6 pH in boiler system. Supply necessary chemicals to give above pH value. Chemicals must be approved by Ontario Ministry of Environment for this use and disposal.
- .7 During cleaning operation, runtal units shall be disconnected and their hose connections used to by-pass water around each unit. Operate heating boiler to maintain 95°F (35°C) system water temperature. DO NOT EXCEED 109°F (43°C).

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- .8 Install treatment feeders for each piping system. Mount each feeder in by-pass around pumps in accordance with Manufacturer's directions. Provide valves and unions not supplied by Manufacturer.
- .9 Charge system 20 lb/1000 gallons (9 kg/4500L) to give a Molybdate concentration of 70 ppm. Provide test kits for chemical treatment systems and instruct Owner's staff in their use. Provide monthly inspections over the Two-year warranty period to check system. Issue a monthly report to the Owner and the Consultant.
- .10 Water Treatment Supplier to prepare final report on the system condition after all flushing and charging is complete.

2.2 Cleaning & Flushing

- .1 The Water Treatment Company will direct and supervise the entire cleaning and flushing operation of the new system and witness the following:
 - .1 The system is flushed of all sand, gravel, and filings before cleaner is added.
 - .2 The proper strength of cleaner is added and circulated for the prescribed time.
 - .3 The system is thoroughly flushed again before chemicals are added.
 - .4 The proper dosage of chemicals is added.
 - .5 Cartridge filters are replaced at the proper intervals.
 - .6 Cabinet Heaters, radiant panels and runtal radiation are by-passed during the flushing process.
- .2 Provide written confirmation to the Consultant that the above was completed. The system air vents shall not be installed until written confirmation is received.

2.3 Chemical Treatment for the Boiler Heating Systems

- .1 Supply and install Dearborn type HV chemical feeder with a capacity of 1.76 gallons (8l) across the suction and discharge of one Boiler system circulating pump. Feeder shall be complete with check, isolation valves, and all accessories shown.
- .2 Supply a 50 lb (24 kg) pail equal to Dearborn 545 liquid formula (low solid treatment) and a test kit, Code #2508 for Molybdate. Supply MSDS sheets to Owner.
- .3 Supply and install on the boiler heating system, a 3/4" (20 mm) filter complete with 30 spare filters.
- .4 Supply and install a 3/4" (20 mm) water meter in cold water make-up to heating system.

2.4 Manufacturers

- .1 Base Bid: Aquarian Ph: 905-825-3711
- .2 Alternate Products: None

PART 3 - EXECUTION

3.1 Installation

- .1 Provide adequate clearance to permit performance and servicing and maintenance of equipment.
- .2 Pipe all drains and relief's to drain.

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- .3 Chemicals must be approved by the Ontario Ministry of the Environment for this use and disposal.
- .4 Isolate new pipe system from existing pipe system when cleaning, flushing and adding chemicals.
- .5 Chemicals must be approved by the Ontario Ministry of the Environment for this use and disposal. The system air vents shall not be removed until written confirmation is received.
- .6 Supply and install, every 100'-0" (30 metres) in building heating pipe system, high capacity hose connections for high velocity flushing.

3.2 Warranty Period

- .1 Provide initial review of system connection and water analysis. Recommend treatment dosages.
- .2 Provide the services of the Water Treatment Company representative for start-up assistance to instruct personnel in the use of chemicals.
- .3 Provide system review and treatment analysis, reports, charts and log sheets every 90 days during the warranty period.
- .4 Provide all necessary laboratory and technical assistance.

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Electric Motors

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.
- .2 Electric motors for all driven equipment supplied by this Division shall be provided and installed by this Division.

1.2 Submittals

- .1 Submit Shop Drawings for all electrical motors in accordance with the Section 15011 - Submittals and shall incorporate the following information.
 - .1 Horsepower
 - .2 Voltage
 - .3 Frequency
 - .4 Speed
 - .5 Starting current and torque characteristics
 - .6 Full load current
 - .7 Class of insulation
 - .8 Enclosure type
 - .9 Service factor
 - .10 Ambient temperature reference
 - .11 Type of bearings
 - .12 Locations of connection box
 - .13 Manufacturer

PART 2 - PRODUCTS

2.1 Materials

- .1 Unless otherwise specified motors shall be squirrel cage induction type with standard drip proof enclosure.
- .2 Motors unless otherwise specified shall meet all requirements of EEMAC and CSA standards for electrical motors and where possible shall be of Canadian Manufacturer.
- .3 Generally, all motors shall have starting current-torque characteristics in accordance with EEMAC, Design 8 unless otherwise specified or unless load characteristics require a higher starting torque. Each motor shall have sufficient starting torque to start the driven equipment and to accelerate it to full speed within 10 seconds. Motor horsepower's shown are minimums. Submit starting times for review.
- .4 All motors shall be nominal 1750 rpm, unless otherwise specified.
- .5 Unless noted otherwise, all motors shall have Class 8 insulation and shall be designed for continuous operation at 40 deg. C. (deg. F.) Motors controlled from variable speed drives shall have Class H windings and Class F insulation.
- .6 Motor connection boxes shall be located on side of motor most easily accessible for maintenance and remote from belts, gears or driven equipment. If boxes are factory installed on wrong side of motor they shall be relocated.

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- .7 Each multi-speed motor and associated switching device shall be circuited such that the overload device in the starter protects the motor on each step of the multi-speed switch. As an alternative to this requirement, the motor may have integral overload protection. Multi-speed motors shall be single winding variable torque for 50% motor speed reduction and double winding, two speed for all other speed reductions.
- .8 Motors shall have the following electrical characteristics:
 - .1 For 0.375 kW (1/2 HP) and larger 600 Volt, 3 phase, 60 cycle
 - .2 For 0.25 kW (1/3 HP) and smaller 120 Volt, 1 phase, 60 cycle
- .9 Single phase motors 0.25 kW (1/3 HP) and smaller shall be capacitor start.
- .10 All motors 22.4 kW (30 HP) and larger shall have heat detector protection embedded in the windings for connection into the motor control circuit. Protection shall be Siemens thermistor.
- .11 Motor enclosures shall be as follows:
 - .1 If protected from the weather and entraining moisture, use open drip-proof, service factor 1.15.
 - .2 Motors located in air streams shall be selected to operate satisfactorily at maximum temperature and moisture levels of surrounding air.
 - .3 For all other locations, use totally-enclosed fan-cooled, service factor 1.0.
 - .4 Use explosion proof motors where scheduled.
- .12 High efficiency motors shall be T frame, A.C., three phase, meet or exceed the Ontario Hydro Enermark Motor Efficiency Levels as tested to either CSA 390M or IEEE-1128, meet or exceed ASHRAE Standard 90.1 (latest edition) motor high efficiency level and be approved under the Canadian Electrical Safety Code:
 - .1 High efficiency motors shall be used on all fans and pumps having motors 0.75 kW (1 HP) or larger.
- .13 Each electric motor shall be complete with a lamacoid nameplate securely fastened in a conspicuous place on the motor. The nameplate shall be a minimum of 2 mm (3/32") thick laminated phenolic plastic 100 mm (4") long x 50 mm (2") wide with black face and white centre, 5 mm (7/32") high letters shall be engraved through to the white lamination with the following:
 - .1 Motor No.
 - .2 Mechanical Equipment Driven
 - .3 Circuit No.
 - .4 Panel No.
 - .5 Panel Location
- .14 Electric motors shall be manufactured by Canadian General Electric, Westinghouse, Lincoln, U.S. Motors, Baldor or Weg.

PART 3 - EXECUTION

3.1 Installation

- .1 Drive between any motor and driven equipment shall be provided with a guard, except where casing acts as a guard. Guards for belt-driven equipment shall have a hole for tachometer reading on each shaft.

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Noise & Vibration Control

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.

1.2 Related Work Specified Elsewhere

.1	Basic Materials & Methods	Section 15050
.2	Liquid Heat Transfer	Section 15700
.3	Air Distribution	Section 15800
.4	Refrigeration	Section 15950

1.3 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 - Submittals for the following equipment:
 - .1 Vibration Isolators

1.4 Scope of Work

- .1 Supply all vibration and sound isolation equipment as indicated on the Drawings and as outlined in the Specifications.
- .2 Isolation is not required for sewage and sump pumps, propeller fans, curb mounted roof fans, or packaged equipment with integral vibration isolation.
- .3 The vibration and sound isolation Manufacturer to visit the site after all equipment has been installed and provide a report to the Consultant verifying that the equipment has been installed and is operating properly.
- .4 The vibration and sound control Manufacturer to submit to the Consultant for approval a list of equipment to be isolated and the selected isolator type for each piece of equipment.
- .5 The vibration and sound control Manufacturer to provide all necessary installation Drawings showing isolator location, base dimensions, etc.
- .6 This Division to provide to the vibration and sound control Manufacturer all the necessary data required for the proper selection of the vibration isolation and sound control equipment. Verify all final dimensions for bases, and plenums.
- .7 This Division to Provide support angles for utility fans, where required, or as detailed on the Drawings.
- .8 Isolators and restraining devices which are factory supplied with equipment to meet the requirements of this Section.
- .9 Select isolators at the Supplier's optimum recommended loading, and do not load beyond the limit specified in the Manufacturer's literature.
- .10 Provide hot dipped galvanized housings and neoprene coated springs for all spring isolators located out of doors or in areas where moisture may cause corrosion.

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- .11 Supply of all of the noise control and vibration isolation equipment to be by one approved Supplier with the exception of those components which are factory installed and are standard equipment with the machinery.

PART 2 - PRODUCTS

2.1 Vibration Isolation

- .1 The work under this Section shall be carried out by a firm specializing in vibration and sound isolation. Isolate fans, piping and ductwork to provide a minimum noise transmission into occupied areas. All vibration isolation material shall be supplied by one (1) Manufacturer directly to this Trade Contractor, except for the chiller units and rooftop units.
- .2 Supply to the Isolation Manufacturer, a copy of Shop Drawings showing equipment weights, isolator locations, concrete slab dimensions, anchor positions, etc. The Isolation Manufacturer shall supply installation instructions and supervision where required to obtain optimum results.
- .3 On system start-up, the Isolation Manufacturer shall inspect the complete installation and report in writing to the Consultant any changes necessary to prevent short circuit transmission.
- .4 All piping connected to isolated equipment shall be suspended with Type 'SH' spring hangers for the first four (4) points of support. Isolate muffler and exhaust pipe of electrical generator.
- .5 All piping supported from floor shall be mounted on Type 'KIP' pads.
- .6 Sleeves through walls and floors of Mechanical Room for ducts and pipes are to be tightly packed with Consolidated Kinetics Corporation low density fibreglass Type 'LB' packing and sealed with 1/2" (12 mm) deep resilient sealant.
- .7 All floor-mounted fans and cabinet-type fan units shall be mounted or suspended on open spring mounts, having a ratio of one between horizontal and vertical constants and a minimum deflection of 1" (25 mm).
- .8 Acceptable Products:
 - .1 Vibro Acoustics
 - .2 Korfund
 - .3 Masdom
 - .4 Kinetics Noise Control
 - .5 IAC Acoustics

2.2 Vibration Isolation Types

- .1 All isolators to be of the types listed below.
- .2 VSV PAD TYPE ISOLATORS - these isolators shall be constructed of layers of 3/8" (10 mm) thick, 60 durometer neoprene vibropad separated by a 10 gauge steel sheet and loaded to less than 50 psi (345 kPa).

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- .3 V TYPE SPRING ISOLATORS - these isolators to be housed type isolators with rubber snubbers separating the top and bottom housings to prevent short circuiting. The isolators to be supported on 3/8" (10 mm) thick ribbed neoprene vibropad to act as a noise break. Provide colour coded springs for ease of identification. Levelling adjustment to be a feature of each isolator.
- .4 VO TYPE SPRING ISOLATOR - these isolators to be open-type free standing spring isolators with equal stiffness in the horizontal and vertical planes. They are to be supported on 3/8" (10 mm) thick ribbed neoprene vibropad to act as a noise break. Provide colour coded springs for ease of identification. Levelling adjustment to be feature of each isolator.
- .5 VOI TYPE SPRING ISOLATORS - these isolators to be open-type free standing spring isolators supported on a 3/8" (10 mm) ribbed neoprene vibropad to act as a noise break. The springs to have equal stiffness in the horizontal and vertical planes and be colour coded for ease of identification. The isolator to support equipment by means of a top plate, covered with a 3/8" (10 mm) thick ribbed neoprene vibropad. Adjustment to be internal such that no bolting to the equipment is necessary.
- .6 VH SPRING HANGER ISOLATORS - these isolators to be box type spring hangers with colour coded springs and an elastomer element in series with the spring to stop high frequency sound.
- .7 VOR TYPE SPRING ISOLATORS - these isolators to be open-type spring isolators with equal stiffness in the horizontal and vertical planes. They are to be supported on 3/8" (10 mm) thick ribbed neoprene vibropad to act as a noise break. Provide colour coded springs for ease of identification. The isolators to have built-in limit stops to prevent lifting and stressing of equipment and connect piping if fluid is removed or drained.
- .8 HD TYPE ISOLATORS - these isolators to be colour coded neoprene-in-shear hangers with a box type housing.
- .9 Design Based on Vibron Ltd.
- .10 Acceptable Products:
 - .1 Vibron Ltd.
 - .2 BVA Systems
 - .3 J.P. Environmental Product Ltd.
 - .4 Korfund
 - .5 IAC Acoustics

PART 3 - EXECUTION

3.1 Vibration Isolators

- .1 Execute the work in accordance with the Specification and, where applicable, in accordance with the Manufacturer's instructions and only by tradespersons experienced in this type of work.
- .2 For all equipment mounted on vibration isolators, provide a minimum clearance of 2" (50 mm) to other structures, piping, equipment, etc.
- .3 Co-ordinate with Section 15800 - Air Distribution flexible connections for all ductwork connections to fans or plenums.

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- .4 For all electrical connections to isolated equipment, Provide flexible conduit suspended in a semi-circular loop.
 - .5 The use of springs as the piping isolation element shall be consistent with the method of isolation of the equipment to which the piping is connected, e.g., spring hangers on piping connected to equipment isolated on springs. The deflection shall be the same as specified for the equipment mounts.
 - .6 Piping holes shall be sleeved to at least 2" (50 mm) greater diameter than the pipe when the piping is supported on vibration isolators. After installation of the pipe the open space shall be packed with mineral wool and a mastic sealing compound used on both sides unless the sleeve penetrates a fire separation, where a fire stopping compound will have to be used.
 - .7 Install hangers midway down the hanger rod in order that the hangers are self-aligning and are installed without binding.

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.

1.2 Related Work Specified Elsewhere

.1	Basic Materials & Methods	Section 15050
.2	Plumbing Fixtures & Trim	Section 15401
.3	Liquid Heat Transfer	Section 15700
.4	Air Distribution	Section 15800
.5	Refrigeration	Section 15950

1.3 Clarification

- .1 Insulation may extend through fire rated separations when used in conjunction with firestopping material specifically tested for this purpose.

PART 2 - PRODUCTS

2.1 General

- .1 For adhesives and mastics for applications noted equal Products of the following Manufacturers will be accepted: Flintkote; Benjamin Foster; Minnesota Mining and Manufacturing; Pronto.
- .2 Insulation shall conform to ASHRAE Standard 90.1 (latest edition).
- .3 All insulation and covering materials are to be non-combustible, and asbestos free. Vapour barrier jacket, and adhesive to be fire retardant to approved standards of fire hazard classification for building materials. Flame spread rating not to exceed 25 and smoke rating not to exceed 50.
- .4 "Koolphen K" phenolic foam insulation with a thermal conductivity of 0.13 BTU.in/Hr.Ft Sq.°F and factory applied ASJ jacket is acceptable, except where piping is exposed then PVC jacketing is required. Thickness of insulation shall provide equivalent or better thermal resistance (R-factor) than specified.
- .5 Acceptable Products:
 - .1 Manson Insulation
 - .2 Knauf
 - .3 Owens Corning

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2.2 Materials

.1 Domestic Cold Water:

- .1 Piping: Fibreglass heavy density fibreglass insulation with factory applied all service vapour barrier jacket lapped and adhered with Flintkote 203 adhesive or equal. Insulation conductivity shall be in the range of 0.22 - 0.28 BTU in/(h.ft³.°F) with mean temperature of 100°F. Seal all joints with 4" (100 mm) wide strip of all service jacket material. Finished with a smooth layer of asbestos free finishing cement and covered with canvas.
- .2 Fittings and valves: Moulded or fabricated mitred segments of a thickness equal to that of the pipe insulation and finished with a layer of asbestos free finishing cement, trowelled smooth and covered with canvas.
- .3 Alternative method for insulating fittings: Pre-moulded high impact PVC fitting covers with fibreglass inserts, end joints sealed with PVC tape.
- .4 Exposed insulation: Finish with PVC vapour barrier jacket and adhere with cement adhesive. Seal all joints with 4" (100 mm) wide strip of PVC tape. Colour of tape to match PVC cover.
- .5 Insulation shall be of thicknesses as follows:

Pipe Size	Insulation Thickness
1/2" (13 mm) - 1-1/4" (32 mm) Ø pipe	1/2" (15 mm)
1-1/2" (40 mm) - 8" (200 mm) Ø pipe	1" (25 mm)

.2 Domestic Hot Water, Tempered, Domestic Hot Water Recirculation Piping:

- .1 Piping: Fibreglass heavy density fibreglass insulation with factory applied all service jacket lapped and adhered with Flintkote #203 adhesive or equal. Seal all joints with 4" (100 mm) wide strip of all service jacket material. Insulation conductivity shall be in the range of 0.22 - 0.28 BTU in/(h.ft³.°F) with mean temperature of 100°F (38°C).
- .2 Fittings and Valves: Moulded or fabricated mitred segments of a thickness equal to that of the pipe insulation and finished with a layer of asbestos free finishing cement, trowelled smooth and covered with canvas.
- .3 Alternative method for insulating fittings: Pre-moulded high impact PVC fitting covers with fibreglass inserts, end joints sealed with PVC tape.
- .4 Exposed Insulation: Finish with PVC vapour barrier jacket and adhere with cement adhesive. Seal all joints with 4" (100 mm) wide strip of PVC tape.
- .5 Insulation shall be of thicknesses as follows:

Pipe Size	Insulation Thickness
1/2" (15 mm) - 1-1/4" (32 mm) Ø pipe	1" (25 mm)
1-1/2" (40 mm) - 4" (100 mm) Ø pipe	1-1/2" (40 mm)

.3 Rainwater Leaders, Horizontal Storm Piping, Cold Condensate Piping:

- .1 Piping: 1/2" (15 mm) Fibreglass heavy density fibreglass insulation with factory applied all service vapour barrier jacket lapped and adhered with Flintkote 203 adhesive or equal. Seal all joints with 4" (100 mm) wide strip of all service jacket material.
- .2 Base of roof hoppers insulated with moulded segments of a thickness equal to that of the pipe insulation finish with cement and wrapped with canvas.

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- .3 Alternative method for insulating fittings: Pre-moulded high impact PVC fitting covers with fibreglass inserts, end joints sealed with PVC tape.
- .4 Exposed Insulation: Finish with PVC vapour barrier jacket and adhere with cement adhesive. Seal all joints with 4" (100 mm) wide strip of PVC tape.

.4 Heating Supply and Return Piping:

- .1 Piping: Fibreglass heavy density fibreglass insulation with factory applied all service jacket lapped and adhered with Flintkote #203 adhesive or equal. Seal all joints with 4" (100 mm) wide strip of all service jacket material. Insulation conductivity shall be in the range of 0.25 - 0.29 BTU. in./(h.ft.³°F) with mean temperature of 125°F.
- .2 Fittings Valves and Flanges: Moulded or fabricated segments of a thickness equal to that of the pipe insulation and finished with a layer of asbestos free finishing cement, trowelled smooth and covered with canvas.
- .3 Alternative method for insulating fittings: Pre-moulded high impact PVC fitting covers with fibreglass inserts, end joints sealed with PVC tape.
- .4 Exposed Insulation: Finish with PVC vapour barrier jacket and adhere with cement adhesive. Seal all joints with 4" (100 mm) wide strip of PVC tape.
- .5 Insulation shall be of thicknesses as follows:

Pipe Size	Insulation Thickness
1/2" (15 mm) - 1-1/4" (32 mm) Ø pipe	1-1/2" (40 mm)
1-1/2" (40 mm) - 8" (200 mm) Ø pipe	2" (50 mm)

- .6 Unions and piping between shutoff valve and coil not exceeding 4'-0" (1200 mm) do not have to be insulated.
- .5 **Hot Water and Drain Piping at Handicapped Fixtures:**
 - .1 Armstrong Armaflex 2000 self seal pipe insulation, closed cell elastomeric and flexible, 1/2" (15 mm) thickness. Secure joints with 3M #471 tape.
 - .2 Exposed Insulation: Finish with one (1) piece PVC vapour barrier jacket and adhere with adhesive.
- .6 **Radiant Panels:**
 - .1 Supply and install 1" (25 mm) thick mineral fibre thermal batt insulation complete with reflective foil face Type III, Class A. Insulation to rest on panel for the entire length and width. Co-ordinate with panel Manufacturer.
- .7 **Fire Separations:**
 - .1 Where ducts pass through fire separations (walls, floor and partitions) pack space with ULC listed and/or approved fire stopping mineral fibre insulation and seal with approved fire-retardant sealing compounding. Sealing compound to be installed to Manufacturer's Specifications and detail. Fire stopping shall comply with the Ontario Building Code and approved by local Building Department. Obtain written approval from Local Building Department before commencing with Work.
 - .2 It is the responsibility of this Division to determine the locations of all fire separations, as shown on the Architectural Contract Documents.

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- .3 Pipes complete with insulation, passing through a fire rated separation must be complete with fire stop mineral wool insulation type RXL-Safe as supplied by ROXUL Inc. Sealant shall be Fyre-Sil for vertical separations and Fyre-Sil SL for horizontal separations. Insulation shall extend a minimum 600 mm (24") beyond face, both sides of the separation.
- .8 **Ductwork:**
 - .1 External (Rigid) Larger than 17" x 13" (425 mm x 325 mm): Fibreglass rigid vapour seal type (AF530) 3.0 PCF (48 kg/m³) in exposed areas finish with 8 oz. (227 gm) canvas adhered with welding pins on 12" (305 mm) to 18" (457 mm) centres, secured with clips. Apply to outside of ductwork. (Min R - Value of 4.0/in.).
 - .2 External (Flexible) Up to 16" x 12" (400 mm x 300 mm): Fibreglass all service faced flexible duct insulation 0.75 PCF (12 kg/m³) with factory applied reinforced foil facing. In exposed areas finish with 8 oz. (227 gm) canvas, adhere with fire retardant adhesive, applied in strips 6" (150 mm) wide and 12" (305 mm) on centres applied to outside of ductwork. (Min R-Value of 2.5/in).
 - .3 Internal (Acoustic Duct Liner): 1" (25 mm) thick fibreglass duct liner or thickness as indicated, with neoprene coating. Adhere with minimum 50% covering of fire retardant adhesive, and supplement with welding pins. (Min R - Value of 4.0/in.). Designated on Drawings by diagonal hatching or where noted.
- .9 **Exposed Ductwork Inside:**
 - .1 All exposed ductwork located in Mechanical Rooms, etc., shall be canvas covered with 6 oz. (0.17 kg) fireproof canvas, complete with two coats Bakor #120-18.
 - .2 Exterior insulation is not required where interior sound insulation is installed.
- .10 **Plenums:**
 - .1 Insulate plenums with insulation board, 2" (50 mm) thick, 6.0 lb/ft³ (96 kg/m³) density.
 - .2 Seal all breaks with Bakor. Cover with foil-faced tape.
 - .3 All insulation shall be secured to flat sheet metal surface by means of welded pins or perforated base metal fasteners adhered with Bakor #230-35 and speed washers. These shall be located on maximum 12" (300 mm) centres. When the insulation has been placed on the metal spike, the speed washers shall be attached, and the excess spike cut off flush with the washer. Corners of insulation shall be provided with a preformed, protective edge applied to insulation before canvassing. See Section 15801.
 - .4 On completion, surfaces shall be canvas covered with 6 oz. (.17 kg) fireproof canvas and finished with two (2) coats of Bakor #120-09.

PART 3 - EXECUTION

3.1 General

- .1 Do not apply insulating materials until equipment to be insulated has been properly cleaned, dried and tested to the satisfaction of the Consultant.
- .2 Apply all insulation, wrapping, vapour barrier, adhesives, coatings, and cement in strict accordance with Manufacturer's recommendations.

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- .3 Do not apply any insulation or finishing when the ambient temperature in the space is less than 50°F (10°C).
- .4 Supply and install on all insulated piping a protection saddles similar to Anvil Fig. 160.

3.2 Installation Application

- .1 Apply all covering in a neat and workmanlike manner to present a clean appearance upon completion of the job.
- .2 Apply all insulation in a manner to facilitate replacing and/or servicing of equipment.
- .3 Make good and refinish cracks, undulations or any other deficiencies occurring in the insulation or vapour barrier.
- .4 On all piping, equipment and ductwork, terminate the insulation neatly around all openings and items requiring periodic access. Insulate separately with removable 16 gauge galvanized sheet steel panels lined with rigid slab insulating materials providing equivalent insulation to that on the adjoining surface.
- .5 Provide metal corners concealed within the canvas finish on all exposed rigid duct insulation.
- .6 Do not use staples on vapour barriers.
- .7 Provide the following insulation Work:
 - .1 All supply ducting
 - .2 All new combustion air ducting - 1" (25 mm) rigid external (unless indicated otherwise).
 - .3 Outdoor and exhaust air plenums (warm side of sheetmetal wall).
 - .4 All linear grille/diffuser supply air plenums, boxes or boots.
 - .5 Do not insulate return air ductwork.
 - .6 Do not insulate exhaust air ductwork.
 - .7 Do not insulate pre-insulated flexible ducts.
 - .8 Do not insulate acoustically lined ductwork.
 - .9 All new heating supply and return piping.
 - .10 All domestic water and recirculation piping.
 - .11 All new above grade horizontal storm piping and roof hoppers.
 - .12 Exposed domestic hot water and drain at each handicapped fixture 1/2" (13 mm) pipe insulation.
 - .13 Repair or replace any existing insulation damaged as a result of the Work, or where indicated to be reinsulated. Match existing for thickness and finish, unless exposed, then finish to match new.
- .8 On all piping having vapour barrier jacket, the adjoining section of insulation is to be butted firmly together and the longitudinal seams of the vapour jacket to be sealed with vapour barrier adhesive. End joints are to be sealed with 4" (100 mm) factory furnished vapour barrier strips.
- .9 Apply insulation over clean dry surfaces butting and adjoining sections firmly together and sealing or taping smoothly over joints.

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- .10 Where the pipe hanger is around the insulation, Provide a 6" (150 mm) length at equal thickness of moulded thermo - 12 insulation, protected with a saddle, within the pipe support. Coordinate with Contractor installing hangers referenced in Section 15050 - Basic Materials & Methods.
- .11 Extend pipe and duct insulation and covering through sleeves, walls, floors, ceilings, and structural beams, unless indicated otherwise on Drawings, or other sections of this Specification.
- .12 Cover angles and standing seams which extend beyond face of applied insulation with 1/2" (15 mm) thick blanket of glass fibre insulation fitted with factory applied facing of fire resistant kraft paper. Provide 3" (80 mm) overlap on each side of angle or seam. Apply strips of 1" (25 mm) thick glass fibre insulation board over blanket type insulation, allowing extended portion of angle or seam to project through Work.
- .13 Seal holes, corners, and joints with 3" (80 mm) wide scrim foil tape immediately following application of insulating materials.
- .14 Prior to insulating any ducts, verify with the balancing agency where they will require holes for traverse reading and insulate around their fittings.
- .15 Refer to Section 15800 for Installation of internal duct liner.
- .16 PVC Fitting Cover:
 - .1 The factory pre-molded, one-piece PVC insulated fitting cover shall have the proper factory pre-cut insulation applied to the exposed fitting.
 - .2 The ends of the insulation shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe covering tufted and tucked in, fully insulating the pipe fitting.
 - .3 The one-piece PVC fitting cover is then sealed with Dow-Corning 999A silicone sealant.
 - .4 Cold water shall have all seam edges of the cover sealed with vapour barrier, pressure-sensitive, colour-matching tape.
 - .5 Condensate pipe fitting shall be heavy gauge PVC.

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.

1.2 Related Work Specified Elsewhere

.1	Roofing	Division 07
.2	Miscellaneous Specialties	Section 10800
.3	Basic Materials & Methods	Section 15050
.4	Insulation	Section 15180
.5	Plumbing Fixtures & Trim	Section 15401

1.3 Description of Work

- .1 Supply and installation of complete sanitary drain, waste and vent systems to serve all fixtures, floor and hub drains and equipment, to 3'-0" (1000 mm) outside building.
- .2 Supply and installation of storm water system complete, including roof drains and rain water leaders, to 3'-0" (900 mm) outside of building.
- .3 Supply and installation of all fixtures, floor and hub drains, including miscellaneous fitments, components and accessories to complete entire installation.
- .4 Supply and installation of domestic hot, cold, tempered and recirculation water systems to serve all fixtures and equipment.
- .5 Supply and installation of fire extinguishers as shown on drawings
- .6 Supply and installation of gas distribution from existing gas main to all equipment.
- .7 Supply and installation of drainage piping from fan coil units to sanitary drainage system.
- .8 Supply and installation of automatic trap seal primers complete with associated piping.
- .9 Install roof drains and vent stacks. Coordinate with General Division.

1.4 Quality Assurance

- .1 Conform the latest edition, including Amendments, of the following Codes and Standards.
- .2 Local bylaws and standards.
- .3 Ontario Electrical Safety Code .
- .4 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 332/12 including all amendments.
- .5 ACNBC Canadian Plumbing Code.

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1.5 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 - Submittals for the following equipment:
 - .1 Neutralizing Tank
 - .2 Thermal Expansion Absorber
 - .3 Floor Drains
 - .4 Cleanouts
 - .5 Roof Drains
 - .6 Hose Bibb
 - .7 Emergency Eyewash
 - .8 Roof Vent Caps
 - .9 Solenoid Valves
- .2 Submit inspection certificates obtained from local inspection authorities.
- .3 Submit certificates indicating that all required testing has been completed.

PART 2 - PRODUCTS

2.1 Floor Drains - DESIGNATED FD

- .1 In finished areas, floor drains shall be cast iron body with 5" (127 mm) Type "B" nickel bronze strainer, and trap primer connection. Zurn ZN-211-B-P. In waterproof membrane areas, use Zurn ZN-415 body.
- .2 In unfinished concrete floor areas, floor drains shall be cast iron body with 5" (127 mm) Type "A" nickel bronze heavy duty strainer and trap primer connection. Zurn ZNX-211-A-P. In waterproof membrane areas, use ZNX-415-A-P.
- .3 In quarry tile or ceramic tile floor areas, floor drains shall be cast iron body with 6" x 6" (150 mm x 150 mm) square nickel bronze strainer. Zurn ZNX-211-H-P. In waterproof membrane areas, use Zurn ZNX-401-H-P.
- .4 Hub drains shall be installed next to equipment where only one (1) pipe has to relieve to drain and shall be cast iron body with 4" (100 mm) polished nickel bronze round strainer and trap primer connection. Zurn ZN-211BE-P-YS. In waterproof membrane areas, use Zurn ZN-415-BE-P-YS bucket and trap primer connection. DESIGNATED HD
- .5 Funnel floor drains shall be installed next to equipment where more than one (1) pipe has to relieve to drain and shall be cast iron body with 4" x 8" (100 mm x 200 mm) polished nickel bronze round strainer and trap primer connection. Zurn ZN-211-BF-P. In waterproof membrane areas, use ZN-401-BF-P. DESIGNATED FFD
- .6 Acceptable Products:
 - .1 Zurn
 - .2 Watts
 - .3 Jay R. Smith
 - .4 Mifab

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- .7 Before construction begins, the Prime Mechanical Contractor shall obtain from the General Division the "Room Finish Schedule" for the Project. The Prime Mechanical Contractor and the floor drain manufacturer and/or vendor shall coordinate the type and installation of the various floor drains listed in the Specifications for each Room. If there is a discrepancy, advise the Consultant before submitting the approval drawings for review. Failure to do so will result in the Prime Mechanical Contractor bearing the total cost for replacing the floor drains and repairing the floor to match the existing conditions.

2.2 Roof Drains - DESIGNATED RD

- .1 Provide to the General Division for installation, the roof drains as listed below.
- .2 Standard roof drains shall be cast iron body complete with large sump, roof membrane waterproof flange, under-deck clamp, sump extension, roof sump receiver, aluminum or cast iron dome strainer and vandal-proof secured dome. Zurn Z-121-VP.
- .3 Standard roof control flow drains shall be as for standard roof drain, except with multi-weir barrier with clamping device and gravel guard with maximum 6" (150 mm) overflow. Zurn ZCF-121 (weir).
- .4 Canopy drains shall be cast iron body with bronze dome and clamping collar. Zurn ZB-180.
- .5 Scupper drain shall be cast iron body with aluminum clamp collar and strainer. Zurn Z-187 or Zurn Z-189.
- .6 Acceptable Products:
- .1 Zurn
 - .2 Watts
 - .3 J. R. Smith

2.3 Cleanouts - DESIGNATED CO

- .1 Provide at the base of each vertical stack and rainwater leader, Zurn Z-1445.
- .2 Provide on exposed wall areas, accessible pipe chases, and outside grade, Zurn Z-1440.
- .3 Provide on plaster walls, Zurn Z-1446-Z-VP.
- .4 Provide on finished floor areas, Zurn ZN-1602-T, square nickel bronze access cover and frame to suit floor finish.
- .5 Provide in ceramic or quarry tile floor areas, Zurn ZN-1602-T square nickel bronze access cover and frame.
- .6 Provide on unfinished floor areas, Zurn Z-1602-T with cast iron scoriated top.
- .7 Provide on vinyl tile floor areas, Zurn ZN-1614 with nickel bronze top recessed for tile.
- .8 Provide for terrazzo floor areas, Zurn ZN-1607-ST with nickel bronze top recessed for terrazzo.
- .9 Cleanouts installed in water-proofed areas shall be supplied with flashing flange and clamp collar.
- .10 Provide for urinals, Zurn ZSS-1666-1-VP with round stainless steel access cover and neoprene plug.

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- .11 Provide in carpeted floor areas, Zurn ZN-1602 CM round nickel bronze top and carpet marker.
- .12 Cleanouts installed in vinyl sheet flooring shall be Enpoco E3000R5FC.
- .13 Acceptable Products:
 - .1 Zurn
 - .2 Watts
 - .3 Jay R. Smith
 - .4 Enpoco
 - .5 Mifab
- .14 Before construction begins, the Prime Mechanical Contractor shall obtain from the General Division the "Room Finish Schedule" for the Project. The Prime Mechanical Contractor and the cleanout manufacturer and/or vendor shall coordinate the type and installation of the various cleanouts listed in the Specifications for each Room. If there is a discrepancy, advise the Consultant before submitting the approval drawings for review. Failure to do so will result in the Prime Mechanical Contractor bearing the total cost for replacing the cleanouts and repairing the floor to match the existing conditions.

2.4 Trap Seal Primers - DESIGNATED TSP

- .1 For multiple installation, trap seal primer shall be gravity feed, prime time electronic priming manifold equal to Precision Plumbing Products, Model PT. Manifold openings to be determine on site.
- .2 Unit shall be factory assembled and pre-piped complete with vacuum breaker, bronze body valve, water hammer arrestor, solenoid valve and calibrated type 'L' copper manifold. Manifold complete with brass compression fittings with orificed openings.
- .3 Unit shall be complete with manual over-ride switch, breaker and 24 hour geared timer.
- .4 All components shall be installed in a 16 gauge enclosure complete with access door for surface mounting.
- .5 Install unit to Manufactures instructions.
- .6 For individual installation, supply and install trap seal primer equal to Precision Plumbing Products, Model P-2-500.
- .7 Acceptable Products:
 - .1 Precision Plumbing Products
 - .2 Mifab

2.5 Hose Bib - DESIGNATED HB

- .1 Hose bibb to be Zurn Z-1300, faucet with hose end spout, 1/2" (15 mm) male inlet and adjustable screw flange and vacuum breaker.
 - .1 Acceptable Products:
 - .1 Zurn
 - .2 Watts
 - .3 Mifab
- .2 Interior hose bibbs shall be 1/2" (15 mm) standard hose end with vacuum breaker.

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- .1 For Concealed Piping Installation Walls:
 - .1 Single - Chicago Faucet Model 293-6 complete with E27 DESIGNATED HB-1.
 - .2 Double - Chicago Faucet Model 305-VB-R DESIGNATED HB-2.
- .2 Acceptable Products:
 - .1 Zurn
 - .2 Jay R. Smith
 - .3 Mifab

2.6 Thermal Expansion Absorber - Potable Water Heating

- .1 Supply and install a diaphragm expansion tank specifically designed for potable water heating systems with 40 psi (275 kPa) pre-charge pressure and 125 psi (865 kPa) working pressure, to absorb the expansion of the hot water tank recovery heating, of the size shown on Drawings.
- .2 Connect a cold water supply line to the hot water tank and mount absorber on floor with a thermal loop pipe separation to the hot water tank.
- .3 Acceptable Products:
 - .1 Amtrol
 - .2 Hamlet and Garneau

2.7 Dielectric Unions

- .1 Provide wherever pipes of dissimilar metals are joined.
- .2 Provide insulating unions for pipe sizes 2" (50 mm) and under and flanges for pipe sizes 2-1/2" (65 mm) and over.
- .3 Cast brass adapters may be used where approved by the Consultant.
- .4 Provide an isolating separation wherever piping may touch dissimilar metal studs, joists, concrete, etc.

2.8 Roof Vent Caps

- .1 Pre-insulated aluminum stack-jack flashing with vandal proof cap will be provided by the Roofing Contractor.

2.9 Water Feed Pressure Regulator Systems

- .1 Supply as part of each system water feed regulator, a 3/4" (20 mm) diameter manual feed independent of pressure regulator for quick filling.
- .2 Install backflow preventer to meet plumbing regulations with upstream shut-off valve on each assembly.

2.10 Shock Absorbers

- .1 At each group of fixtures supply and install shock absorber, Zurn Model Z-1700. Contractor shall guaranteed no water hammer for one (1) year. For shock absorbers concealed in walls Provide access door for servicing.

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.2 **Acceptable Products:**

- .1 Zurn
- .2 Watts
- .3 J.R. Smith
- .4 PPP Inc.
- .5 Mifab

2.11 Solenoid Valves - DESIGNATED SV

- .1 Water solenoid valves shall be Ascoelectric Limited Model 8210 Series, brass body, Buna 'N' seals and discs, general purpose enclosure, 1/60/120 Volt. Valves shall close when de-energized and be full pipe size.
- .2 Gas solenoid valves shall be Ascoelectric Limited, Model 8230, manual reset, 2-way solenoid valve, aluminum body, Buna 'N' disc, 1/60/120 Volt, normally closed, general purpose enclosure.
- .3 Solenoid valves shall be selected to suit the design water and air pressures encountered, i.e. 80 psi (550 kPa) for water and 175 (1205 kPa) for compressed air.

PART 3 - EXECUTION

3.1 Plumbing Specialties

.1 **Cleanouts:**

- .1 Before construction begins, the Prime Mechanical Contractor shall obtain from the General Division the "Room Finish Schedule" for the Project. The Prime Mechanical Contractor and the cleanout manufacturer and/or vendor shall coordinate the type and installation of the various cleanouts listed in the Specifications for each Room. If there is a discrepancy, advise the Consultant before submitting the approval drawings for review. Failure to do so will result in the Prime Mechanical Contractor bearing the total cost for replacing the cleanouts and repairing the floor to match the existing conditions.
- .2 Cleanouts to be the same size as pipe up to 4" (100 mm) and not less than 4" (100 mm) for larger pipes.
- .3 Provide cleanouts at the end of mains and branches, at changes in directions, in long straight runs, at the base of all soil stacks and rainwater leaders and where required by code.
- .4 Use extended cleanouts for piping installed below grade and in furred ceiling spaces.
- .5 Co-ordinate final cleanout elevation and configuration with floor finishes.

.2 **Floor & Hub Drains:**

- .1 Before construction begins, the Prime Mechanical Contractor shall obtain from the General Division the "Room Finish Schedule" for the Project. The Prime Mechanical Contractor and the floor drain manufacturer and/or vendor shall coordinate the type and installation of the various floor drains listed in the Specifications for each Room. If there is a discrepancy, advise the Consultant before submitting the approval drawings for review. Failure to do so will result in the Prime Mechanical Contractor bearing the total cost for replacing the floor drains and repairing the floor to match the existing conditions.

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- .2 Reference shall be made to the Architectural Drawings for slopes of floors and locations of floor drains with regard to furniture, benches, etc. and on specific placing.
- .3 Provide drains, complete with traps, where shown on Drawings.
- .4 Provide trap seal primers and supply lines to each drain. All trap seal primers shall be accessible, Provide suitable access doors where necessary.
- .5 Co-ordinate final drain elevation and configuration with floor finishes.
- .3 **Roof/Canopy Drains:**
 - .1 All roof and canopy drains to be supplied and installed by Division 15. Refer to Architectural Drawings for details.
 - .2 Underdeck clamps to drain bases and connection of storm piping to drains to be installed at all drains by the Division 15 Contractor.
- .4 **Water Hammer Arrestors:**
 - .1 Provide 24" (610 mm) air chambers fabricated from Type L, copper tubing, with capped end, or water hammer arrestors, at each plumbing fixture or fixture group, and wherever else necessary to prevent water hammer.
- .5 **Fixture Carriers:**
 - .1 Fasten carriers securely to the building structure with 1/2" (13 mm) bolts and necessary anchors.
 - .2 Verify fixture mounting heights, refer to Section 15401.
- .6 **Eye Wash Station:**
 - .1 Install Emergency Equipment so as to be easily accessible to potential users of the equipment. Location shall have surrounding area free of machinery, equipment or other obstructions.
 - .2 The mounting heights of the shower head and eye wash bowl shall meet the requirements of ANSI Standard Z358.1-1981.
 - .3 Contractor to connect water supply to equipment. The water line shall be thoroughly flushed before equipment is installed.
 - .4 The emergency equipment is to be clearly identified. The means of identification shall include:
 - .5 Installation of a highly visible sign at each unit (sign to be supplied by unit Manufacturer).
 - .6 The equipment and/or surrounding area shall be painted in a highly visible colour.
 - .7 Emergency equipment shall be field tested immediately after installation prior to space being occupied.

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.

1.2 Related Work Specified Elsewhere

.1	Miscellaneous Specialties	Section 10800
.2	Basic Materials & Methods	Section 15050
.3	Insulation	Section 15180
.4	Plumbing	Section 15400

1.3 Quality Assurance

- .1 Conform the latest edition, including Amendments, of the following Codes and Standards.
- .2 Local bylaws and standards.
- .3 Ontario Electrical Safety Code.
- .4 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 322/12 including all amendments.
- .5 ACNBC Canadian Plumbing Code.

1.4 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 for the following equipment:
 - .1 Plumbing Fixtures and Trim
 - .2 Submit inspection certificates obtained from local inspection authorities.
 - .3 Submit certificates indicating that all required testing has been completed.

PART 2 - PRODUCTS

2.1 Plumbing Fixtures

- .1 Plumbing fixtures shall be as indicated and specified with all required supports, accessories, drainage, vent and water connections to make the fixture complete.
- .2 The flow rates of fittings that supply water to a fixture shall not exceed the maximum flow rates listed in Part 7 of the OBC under the water efficiency section.
- .3 All plumbing fixtures shall be Acceptable Products: American Standard, Kohler, Crane manufacture, except where specifically noted as a special manufacture. Designations are Crane. Water closets and urinals shall be certified to CAN/CSA-B45.0. All plumbing fixtures shall be supported level and square.
- .4 Plumbing fixture mixing valve shall be Powers, Alternate Products: Moen (Commercial)
- .5 Flushometer Valve shall be Acceptable Products: Zurn, Delta/Teck, Crane, Moen (Commercial)

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- .6 Water Closet seats shall be Acceptable Products: Zurn, Olsonite and Bemis. Seats to have stainless steel hinge and posts.
- .7 Janitor Sink "JS" shall be Acceptable Products: Zurn, Fiat, Stern Williams.
- .8 Lavatory fittings and supply shall be Acceptable Products: Delta/Teck, Crane, Moen (Commercial).
- .9 Faucets serving all stainless steel sinks shall be Base Bid: Zurn, Delta/Teck, Alternate Products: Crane, Chicago Faucet, Moen (Commercial).
- .10 All fittings shall be "no lead" brass alloy, chrome plated finish. Plastic fittings are not acceptable. Delta fittings are specified. Acceptable Products are Crane, except where specifically noted as special manufacture. Fittings and trim serving lavatory, stainless steel sinks and showers shall be certified to CAN/CSA-B125.
- .11 Faucets serving lavatory shall be "no lead" brass alloy, chrome plated. Plastic fittings are not acceptable. Acceptable Products: Crane, Delta, Zurn.
- .12 Prime Mechanical Contractor shall supply and install all around, white silicone in gap between porcelain plumbing fixture and finished wall/floor/counter top.
- .13 All vitreous china fixtures are white unless specified otherwise.
- .14 Provide each fixture with waste and trap, vent and water, as shown or required in accordance with the following schedule:

Fixture	Trap (mm)	Vent (mm)	Cold (mm)	Hot (mm)	Tempered (mm)
Lavatory	1-1/4" (32)	1-1/4" (32)	1/2" (15)	1/2" (15)	
Water Closet (F.V.)	3" (80)	1-1/2" (40)	1" (25)	--	
Urinal	2" (50)	1-1/2" (40)	3/4" (20)	--	
Janitor's Sink	3" (80)	1-1/2" (40)	1/2" (15)	1/2" (15)	
Sink	1-1/2" (40)	1-1/4" (32)	1/2" (15)	1/2" (15)	
Floor and Hub Drain	3" (80 min.)	1-1/2" (40)	3/8" (10)	--	
Drinking Fountain	1-1/4" (32)	1-1/4" (32)	1/2" (15)	--	
Wash Fountain	2" (50)	1-1/2" (40)	1" (25)	1" (25)	
Non-Freeze Hose Bibb	--	--	3/4" (20)	--	

Note: Exposed drain pipe serving sink, lavatory and laundry tub, is to be finished chrome plate complete with deep cup escutcheon.

- .15 **Water Closet - DESIGNATED WC-1**
(Public Washroom)
 - .1 Closet - ZURN ECOVANTAGE Z5655-BWL1-AM
 - .2 Seat - ZURN Z5956SS-AM elongated seat white
 - .3 Valve - DELTA ZER6000AV-TM-HET-HW (hardwired) complete with hard-wired power converter #P6000-HW6
 - .4 Top Spud - 1-1/2" (40 mm)

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- .16 **Water Closet - DESIGNATED WCH-1**
(Public Washroom)
- .1 Closet - ZURN ECOVANTAGE Z5665-BWL1-AM
 - .2 Seat - ZURN Z5956SS-AM elongated seat white
 - .3 Valve - DELTA ZER6000AV-TM-HET-HW (hardwired) complete with hard-wired power converter #P6000-HW6
 - .4 Top Spud - 1-1/2" (40 mm)
 - .5 Backrest - stainless steel tubular backrest #3777-T1-8
- .17 **Urinal - DESIGNATED U-1**
(Public Washroom)
- .1 Bowl - ZURN Z5755-U wall hung white
 - .2 Fittings - 3/4" (20 mm) inlet spud
- hangers
- 2" (50 mm) outlet
 - .3 Valve - DELTA ZER6003AV-TM-ULF-HW hardwired faucet complete with hard-wired power converter #P6000-HW6
 - .4 Carrier - ZURN Z1221 concealed wall hung urinal carrier
- .18 **Lavatory - DESIGNATED L-1**
(Public Washroom)
- .1 Bowl - ZURN Z5321 wall hung lavatory - white
 - .2 Faucet - ZURN Z6956XL-CWB-F hard-wired faucet complete with hard-wired power converter #P6000-HW6
 - .3 Tailpiece - Strainer offset #290-20515C04
 - .4 Trap - Cast brass P-trap #252-0253C04
 - .5 Supplies - Supplies with extra heavy duty stops #ZH8824XL-LKQ-PC-Z8952-58(2)
 - .6 Mixing Valve - Leonard #170-LF mixing valve
 - .7 Carrier - ZURN Z1231 Concealed Wall Hung Lavatory Carrier
 - .8 Protectors P-trap insulation #Z8946-3-NT
- .19 **Lavatory - DESIGNATED WF-1**
(Public Washroom)
- .1 Bowl - Bradley Washfountain #MF2949 Terreon wall-hung quadra-fount. Serves one to four users, integral molded sprayheads, touch time mechanical pushbutton, thermostatic mixing valve, S.S flexible hose and barrier free pedestal extension. Colour selection by architect
 - .2 Carrier - Matching concealed wall hung lavatory carrier
- .20 **Lavatory - DESIGNATED S-1**
(Public Washroom)
- .1 Bowl - International CA-LMAI601121 S.S. wall hung wash station, 3 users 1525L x 290H x 533 P (60" x 11.5" x 21") complete with stainless steel shroud.

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.2	Faucet	-	ZURN Z6956XL-CWB-F hard-wired faucet complete with hard-wired power converter #P6000-HW6 (3 faucets required)
.3	Supplies	-	Supplies with Zurn ZH8824XL-LKQ-PC/Z8952-58(2) extra heavy duty turn stops
.4	Mixing Valve	-	ZURN ZW1070XL mixing valve
.5	Carrier	-	CAN-AQUA CA-SLMAI concealed wall hung lavatory carrier
- .21 Lavatory - DESIGNATED S-2 (Public Washroom)**
- | | | | |
|----|--------------|---|--|
| .1 | Bowl | - | International #CA-LMAI481121 wall hung wash station, 2 users 1219L x 292H x 533P (48" x 11.5" x 21") complete with stainless steel shroud. |
| .2 | Faucet | - | ZURN Z6956XL-CWB-F hard-wired faucet complete with hard-wired power converter #P6000-HW6 (2 faucets required) |
| .3 | Supplies | - | Supplies with Zurn ZH8824XL-LKQ-PC/Z8952-58(2) extra heavy duty turn stops |
| .4 | Mixing Valve | - | ZURN ZW1070XL mixing valve |
| .5 | Carrier | - | CAN-AQUA CA-SLMAI concealed wall hung lavatory carrier |
- .22 Janitor Sink - DESIGNATED MS**
- | | | | |
|----|---|---|--|
| .1 | Manufacturer | - | Zurn |
| .2 | Type | - | Molded stone |
| .3 | Style | - | Curb style - mop service basin |
| .4 | Model | - | Z1996-24 |
| .5 | Size | - | 24" x 24" x 10" (600 mm x 600 mm x 250 mm) |
| .6 | Supply fittings | - | Z843M4-XL - chrome plated complete with vacuum breaker, integral stops, adjustable wall brace, pail hook and 3/4" (20 mm) hose thread on spout. Body inlets - 8" (200 mm) centres, 4" (100 mm) handles, 1.5 GPM (5.7L) |
| .7 | Accessories: | | |
| .1 | Hose: 30" (750 mm) long heavy duty flexible 5/8" (16 mm) rubber hose. | | |
| .2 | Hose Bracket: #Z1996-MH stainless steel with 3 hooks | | |
| .3 | Bumperguard: stainless steel #Z1996-BS24 | | |
| .4 | Wall Guards: #Z1996-WG24, 600 mm (24") stainless steel, 2 panels | | |
| .8 | Drain Fitting | - | #Z1996-SDL combination stainless steel dome strainer with lint basket |
- .23 Bottle Filler Station- DESIGNATION BFS-1**
- | | |
|----|---|
| .1 | ELKAY bottle filler #EZWS-SFGRNM8K |
| .2 | In-wall barrier free electric water cooler with bottle filler |
| .3 | Stainless steel casing and top with integral strainer |
| .4 | Flexi-guard safety bubbler with push button activation |
| .5 | Side panel sensor activated upper bottle filling station |

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- .6 20-second automatic shutoff timer
- .7 With in-line filter #EWF3000
- .24 **Emergency Eye Wash - DESIGNATED EEW**
 - .1 Haws Model 7260B complete with vacuum breaker complete with bowl, mixing valve 9201EW, drain connection and wall bracket.

PART 3 - EXECUTION

3.1 Plumbing Fixtures

- .1 For precise location and mounting heights of the fixtures and trim, refer to the Architectural Drawings.
- .2 Co-ordinate the Work of this Division with that of other Divisions with regard to all openings in wall and floors for any fully or semi-recessed fixtures.
- .3 Conform with detailed Architectural and Electrical Drawings countertop installation with regard to sink size and location in countertop to ensure clearance with counter structural components and possible interference with countertop electrical outlets.
- .4 Fixtures are to be carefully stored until ready for placing. After placing, they are to be protected by pasting on paper, or other methods, from danger. When job is ready for service all fixtures and fittings are to be properly cleaned. Any scraped, chipped or permanently stained fixtures are to be replaced by the Contractor.
- .5 All Manufacturers labels are to be left on fixtures until after Final Inspection and then removed.
- .6 Each fixture to have compression type shut-off valves at the fixture in addition to the faucets on each fixture. These valves are to be adjusted to prevent excessive flow.
- .7 Where fixtures connections pass into walls, floors, ceilings or through millwork they are to be fitted with proper escutcheons.
- .8 All visible parts of trim of the fixtures including faucets, escutcheons, wastes, strainers, traps, supplies stops, etc., are to be chrome plated.
- .9 When installing chrome plated trim and accessories, proper care is to be taken. Any wrench or other tool marks on the plating is to be sufficient cause for rejection.
- .10 All exposed pipe and fittings and fixtures are to be rigidly supported. All fastenings to walls and partitions are to be firmly made without damage to wall finish.
- .11 Connect all services to plumbing fixtures.
- .12 Install all plumbing fixtures supplied by other Divisions and connect all services to plumbing fixtures.
- .13 Mount handicapped lavatories to maintain a clearance of 28" (710 mm) beneath the fixture to point 10-1/4" (260 mm) from the front. Waste outlet and hot water supply pipes are to be insulated.
- .14 Mechanical Contractor shall supply and install the transformers for all electronic valves and washfountains, control wiring from transformers to valves shall be by this Division. Line voltage to the transformers shall be by Division 16. Refer to Electrical Drawings for co-ordination as to the required number of transformers.
- .15 Refer to Architectural Drawings for mounting heights of all drinking fountains.

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- .16 Mechanical Contractor shall supply and install all around, white silicone in the gap between porcelain plumbing fixture and finished wall/floor.
- .17 Fixtures and fittings:
 - .1 Set urinals (Designated U) from floor to lip height at 24" (600 mm). Support urinal with 24" x 6" x 1/4" (600 mm x 150 mm x 6 mm) steel backplate or unless otherwise specified.
 - .2 Set urinals (Designated U-1) from floor to lip height at 18" (450 mm). Support urinal with 24" x 6" x 1/4" (600 mm x 150 mm x 6 mm) steel backplate or unless otherwise specified.
 - .3 Set Watercloset (Designated WC) remote infrared sensor above flush valve and seat in the upright position.
 - .4 Set Watercloset (Designated WCH) remote infrared sensor above flush valve, handicap grab bar and seat/cover in the upright position.
 - .5 Set Lavatory (Designated L-1) from floor to lip of sink at 31" (775 mm).
 - .6 Set emergency eye wash (Designated EEW) from floor to wall bracket at 48" (1200 mm).
- .18 At the beginning of the job, obtain from the General Division approval Drawings of the millwork. Co-ordinate the installation of stainless steel sinks and lavatories with the millwork. If there is a discrepancy advise the Consultant before submitting approval Drawings. Failure to do this will result in the Contractor bearing the total cost for replacing sinks that do not fit properly in counter tops.

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Domestic Hot Water Heaters

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.

1.2 Related Work Specified Elsewhere

.1	Miscellaneous Specialties	Section 10800
.2	Basic Materials & Methods	Section 15050
.3	Insulation	Section 15180
.4	Plumbing	Section 15400

1.3 Quality Assurance

- .1 Conform the latest edition, including Amendments, of the following Codes and Standards.
- .2 Local bylaws and standards.
- .3 Ontario Electrical Safety Code.
- .4 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 322/12 including all amendments.
- .5 ACNBC Canadian Plumbing Code.

1.4 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 for the following equipment:
 - .1 Hot Water Heater (HWT-1)

PART 2 - PRODUCTS

2.1 Hot Water Heaters - DESIGNATED HWT-1

- .1 Supply and install a commercial electric water heater as indicated on the Drawing schedule. Tank to be complete with thermostatic control, 2" (50 mm) Fibreglass insulation, digital display, combination temperature and pressure relief valve, 100% shut-off pilot, drain, hand-hole cleanout, faucet, draft diverter and gas shut-off valves. Tank shall be CGA approved.
- .2 Design based on A. O. Smith
- .3 Acceptable Products:
 - .1 A. O. Smith
 - .2 John Wood
 - .3 Lochinvar

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Sprinkler Systems

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PART 1 - GENERAL

1.1 Requirements Included

- .1 Conform to Mechanical General Provisions, Section 15010.
- .2 The Sprinkler Contractor to be a sub-trade of the Prime Mechanical Contractor
- .3 This Project requires seismic bracing.

1.2 Related Work Specified Elsewhere

- .1 Basic Materials & Methods Section 15050
- .2 Electrical Work Division 16

1.3 Quality Assurance

- .1 Install, test and have inspected all Work in accordance with the requirements of the Ontario Building Code; National Fire Protection Association (NFPA 13) latest issues; the local authorities having jurisdiction; the Owners insurers; and the Ontario Fire Code.
- .2 All materials - CSA, ULC and HEPC of Ontario approved for the intended applications.

1.4 Scope of Work

- .1 In this Section the word "System" is intended to include all Work related to the item.
- .2 This Section covers the Work for complete systems including:
 - .1 Extension of the existing sprinkler system to serve the Addition.
 - .2 Piping, wet system for construction as identified on the Drawings.
 - .3 Auxiliary equipment and accessories.
 - .4 Connection to existing sprinkler system as shown on Drawings
- .3 Sprinkler system to design to be based on flow test results indicated on Drawings.
- .4 All sprinkler heads, piping to be located to suit structural conditions, electrical and mechanical Work. Contractor is to co-ordinate with other trades before installation. Include for all offsets that may be necessary to fit piping in restricted ceiling spaces.
- .5 Contractor to co-ordinate location and type of equipment to be wired by Division 16 so that fire alarm panels and wiring may be completed without extras to the Contract.
- .6 **Pay all fees as required for flow tests and plans examinations.**
- .7 Provide AutoCAD 2005 (or latest version) compatible disk to Consultant indicating sprinkler system plans, including all as-built revisions and flow test information.

1.5 Qualifications

- .1 Design and construct the automatic sprinkler systems, as indicated and as described hereinafter, using a fully qualified and recognized automatic sprinkler firm regularly engaged in and having an established reputation for this type of Work.
- .2 Use a company that employs qualified and suitably equipped service technicians, and willing to undertake the long term service of the equipment.

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1.6 Submittals

- .1 Use hydraulically designed systems.
- .2 Before commencing with the Sprinkler System installation, this Division shall submit Engineer-stamped 1/8" (1:100) scale working plans with 1/4" (1:50) sections and details and stamped copies of hydraulic calculations stamped "Reviewed by the Authorities and/or agencies having jurisdiction over the installation for approval." Submit to the Architect and Engineer for review, approved and stamped Drawings before commencing installation. Any comments received from the Owner Service Agent shall be reviewed by the Consultant. The Consultant to advise whether comments are to be incorporated into the documents
- .3 Do not start Work under this Section until Shop Drawings have been approved, and/or reviewed by the authorities having jurisdiction.
- .4 Submit Shop Drawings in accordance with Section 15011 for the following equipment:
 - .1 Sprinkler heads
 - .2 All valves (alarm valves and accessories, check valves, gate valves, swing check valves)
 - .3 Pressure & Flow switches
 - .4 Valve supervisory switches
 - .5 Excess pressure pump
 - .6 Double check valve
- .5 Provide letter from Electrical Contractor confirming co-ordination of wiring for all equipment and devices.

1.7 List of Operating & Maintenance Manuals

- .1 Submit operating, maintenance, and parts manual for major equipment to the Consultant, as described in Section 15011.

1.8 Electrical Equipment

- .1 Provide integral or remote controls where specified with all electrical equipment.
- .2 Provide all safeties as required by Code.
- .3 Use approved equipment per above.

1.9 Examination of Site

- .1 This Contractor, before tendering, shall examine the site and all Drawings and Specifications of other trades and familiarize himself with the local conditions, building construction and finish applying the Work under this section. Bring to the attention of the Consultant any areas that coverage may have been omitted from or may require several special considerations. No allowances shall be made for any extra expenses incurred by him through his failure to do so.

PART 2 - PRODUCTS

2.1 Design Criteria

- .1 Design all system using hydraulic calculations.

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- .2 In general Provide all separate zones and electrically supervised valves, separately annunciated at the fire alarm annunciator panel as shown on the Drawings.
- .3 The design data on the Drawings is provided only in order to allow an equal basis for the tender. A flow test to be provided by the Sprinkler Contractor before doing final calculations.
- .4 Sprinkler Contractor may at his own discretion, design the system using extended coverage sprinkler heads, subject to meeting all the requirements of NFPA-13 and the authorities having jurisdiction.
- .5 Sprinkler Contractor is responsible for the complete design of the system, no extras will be allowed after tendering for any items which are required by the code, whether they are indicated on the Drawing or not.
- .6 The systems shall be hydraulically calculated, designed and submitted to approving agencies by the trade responsible for the installation. Occupancies for the various areas are shown on the Drawings.
- .7 When awarded the Contract, existing hydrants nearest to the new fire line connection are to be flow tested by the trade responsible for the installation of the Sprinkler System and the results used for the hydraulic calculations. Provide a copy of the test results to the Consultant.
- .8 System shall be design with a minimum 10 psig safety factor to allow for future pressure reductions.

2.2 Items Not Included (As Per Plans & Specification For Clarification Only)

- .1 All electrical power, alarm and supervisory wiring

2.3 Pipe & Fittings

- .1 4" (100 mm) and above: Schedule 40 electric weld black steel pipe in accordance with ASTM-A-120.
- .2 1" (25 mm) - 2" (50 mm): Schedule 10 continuous weld black steel pipe in accordance with ASTM-A-120.
- .3 1/2" (65 mm) and above: Schedule 10 electric weld black steel pipe in accordance with ASTM-A-120.
- .4 **Note:** Schedule 5 piping will not be permitted on this Project.
- .5 Provide fittings of cast or malleable iron in compliance with the National Fire Protection Association standards for a working pressure of not less than 175 psig (1207 kPa). Grooved end fittings are equally acceptable.
- .6 Provide screwed fittings for pipe sizes 3" (75 mm) diameter and under, to suit the National Fire Protection Association.
- .7 Hangers serving pipes 3" (80 mm) diameter and smaller are to be adjustable swivel ring type, Anvil Fig. 69. Hangers serving pipes 4" (100 mm) diameter and larger to be adjustable wrought clevis type Anvil Fig. 260. All hangers to be prime coat painted. Zinc or cadmium plated hangers shall be installed in corrosive areas only. Hanger rods to be similar to hanger and sized to Manufacturer's recommendations. **DO NOT SUPPORT FROM METAL DECK.**

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2.4 Sprinkler Heads

- .1 Automatic sprinkler heads approved by the National Fire Protection Association.
- .2 Standard Temperature rating of sprinkler heads 165°F (74°C). Where necessary, use intermediate and high temperature rating heads to suit local conditions.
- .3 Provide sprinkler heads in locations indicated on Drawings and of the following type:
 - .1 Upright and pendent heads with bronze body (miscellaneous service and storage rooms) or chrome finish (exposed public areas) - GEM Universal Model A bulb type, 1/2" (13 mm) orifice.
 - .2 Recessed pendent - GEM model F972 bulb type, 1/2" (15 mm) orifice, with bright chrome finish, and white escutcheon.
 - .3 Sidewall GEM Universal model A bulb type, 1/2" (15 mm) orifice, with bronze or chrome finish and escutcheon (where required).
 - .4 Vertical sidewall GEM Universal model A bulb type, 1/2" (15 mm) orifice, with bronze or chrome finish.
- .4 Include in the Contract for the supply and installation of an additional five (5) sprinkler heads complete with 10 meters of 25 mm diameter piping to be used as required to suit final reflected ceiling layouts.
- .5 Locate heads in a symmetrical pattern to miss lighting outlets, fixtures, ductwork and piping, concrete or steel structure, and centred in tile in both directions unless written approval is received from the Architect.
- .6 Acceptable Products:
 - .1 GEM Sprinkler Company
 - .2 Viking Sprinkler Company
 - .3 Grinnell Company of Canada Limited
 - .4 Central Sprinkler Company
 - .5 Globe Fire Protection Corporation
- .7 Provide sprinkler head guards Gem model F774 in Mechanical Room.

2.5 Valves

- .1 Have all valves supplied with the Manufacturer's name and pressure rating clearly marked on the outside of the body.
- .2 Supply all valves ULC approved, and bear ULC labels.
- .3 **Shut-Off Valves:**
 - .1 Except as hereinafter specified, valves used on the system shall be 175 psi(1207 kPa), O.S. & Y.
 - .2 Flanged valves - 2 1/2" (65 mm) and over as manufactured by McAvity, (Crane), Jenkins, Mueller.
 - .3 Screwed valves smaller than 2" (50 mm) diameter as manufactured by Crane Canada Ltd., Jenkins .
 - .4 Butterfly valves - 2 1/2" (65 mm) and over as manufactured by Grinnell, Jenkins, Mueller.
- .4 Wiring from the supervised valve up to and including the supervisory annunciator is specified under Division 16.

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- .5 **Check valves:** 2" (50 mm) and over as manufactured by ITT Kennedy, Mueller, Ritpro, Central.
- .6 All valves shall be ULC approved complete with electrical monitoring switches. Monitoring switches shall have two (2) sets of contacts. Plug type switches are not acceptable.

2.6 Flow Switches

- .1 Provide flow switches where indicated 2" (50 mm) and above. GEM model VSR-F, Vane type water flow detectors. 1" (25 mm) - 1-1/2" (40 mm) GEM Model VS-SP, paddle type water flow detectors. Connection to the fire alarm system is specified under Electrical Division 16.
- .2 Acceptable Products:
 - .1 Potter Electric Signal and MFG Co. Ltd. - VSR-D
 - .2 Reliable Model A
 - .3 Viking Corporation VSR-D.

2.7 Alarm Valves

- .1 Alarm devices as manufactured by:
 - .1 Reliable Automatic Sprinkler Company
 - .2 GEM Sprinkler Company
 - .3 Viking Sprinkler Company
 - .4 Grinnell Company of Canada Limited
 - .5 Star Sprinkler Corporation
 - .6 Central Sprinkler Company
 - .7 Globe Fire Protection Corporation
- .2 Wet systems - GEM model F200 & F2001 complete with all associated trim and excess pressure pump.

2.8 Supervisory Switches

- .1 Valves, where indicated, are to be Provided with ULC Approved supervisory switches.
- .2 For O.S.& Y. gate valves - Potter Electric Signal & Mfg. Co. Ltd. model OSYS-U.
For butterfly valves - Potter Electric Signal & Mfg. Co. Ltd. model PIVS-U.
- .3 Acceptable Manufacturers:
 - .1 Grinnell Fire Protection Systems
 - .2 ADT Security System

2.9 Pressure Switches

- .1 Provide pressure operated water flow and ULC Approved supervisory switches suitable for wet pipe systems.
 - .1 Wet Systems - Potter Electric Signal & Manufacturing Co. Ltd., Model PSS-120.
 - .2 Water Flow Switch - Potter Electric Signal & Manufacturing Co. Ltd., Model WFS-5.

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- .2 Acceptable Manufacturers:
 - .1 ADT Security Systems
 - .2 Grinnell Fire Protection Systems

2.10 Identification Signs

- .1 Provide each shut-off valve, drain valve, and test valve with a sign. Minimum size for automatic control valves: 6" x 6" (150 mm x 150 mm); 6" x 2" (150 mm x 50 mm) for other valves. Provide inscription in accordance with the National Fire Protection Association standards. Provide signs of enamelled steel with Fire Department red enamel background, white enamel letters and fasten them in a workmanlike manner to the pipe, valve or wall in the immediate vicinity of the valve identified.
- .2 Provide each valve supervisory switch, flow switch, pressure switch etc. with a sign. Provide signs of lamacoid with Fire Department red background, white letters, with inscription identifying the function of each device in conjunction with the fire alarm annunciation panel. Secure labels to each device.

2.11 Drains For Test Connections

- .1 Provide test connections in accordance with the National Fire Protection Association (NFPA 13) requirements and run the drain line to the nearest floor drain, catchbasin or exterior, as indicated on Drawings.

2.12 Pipe Hangers

- .1 Provide pipe hangers and supports as manufactured by Myatt or Anvil and approved by NFPA.
- .2 Grabber or other perforated or flat iron hangers are not accepted.
- .3 Suspend hangers from the concrete floor slabs and/or attach hanger rods or clamps to structural roof steel truss, according to the Shop Drawings approved by the Structural Engineer. **DO NOT SUSPEND FROM METAL DECK.**
- .4 Provide any additional steel required for the support of additional hangers. Installation of such supports to be approved before erection. Space hangers and supports in strict accordance with the National Fire Protection Association (NFPA 13) requirements.

2.13 Floor Plates

- .1 Provide heavy black finish cast iron plates where exposed pipes pass through finished walls or floors. Provide similar plates at ceilings, but with set screws to hold them in place. Manufactured by Anvil: Wall or floor plates #396, ceiling plates #395.

2.14 Excess Pressure Pump FP-1 (Jockey Pump)

- .1 ULC approved Albany or equal complete with pressure switch, check valves, etc. Motor to be 1/3 HP, 60/1/120 Volts and wired for automatic operation.
- .2 Wiring by Division 16.

2.15 Double Check Valve Backflow Preventer Assembly

- .1 Assembly shall be Watts Regulator Ltd., Model 909 RPDA. See Drawings for locations.

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PART 3 - EXECUTION

3.1 Installation

- .1 Design and install the sprinkler systems in accordance with the National Fire Protection Association (NFPA 13 and NFPA 24) requirements.
- .2 Adopt the hazard occupancy classifications as generally indicated in NFPA 13.
- .3 Rigidly support pipework where pipework is installed within 8 ft. (2.4 m) of the floor to ensure stability.
- .4 Refer to water service piping schematic on Drawings to determine the extent of the Work for the respective disciplines.
- .5 Supply and install pressure operated and supervisory switches to perform the following functions:
 - .1 Energize the excess pressure pump to maintain set pressure after the wet pipe alarm valve.
 - .2 Indicate movement of a control valve handle.
 - .3 Indicate at the annunciator panel a loss of excess pressure required in a wet pipe system.
 - .4 Division 16 to Provide power and control wiring for all devices.

3.2 Testing

- .1 Provide all labour, materials and equipment required for testing and pay all fees for inspection and testing. Notify, in writing, the Consultant and the local authorities having jurisdiction of the tests 48 hours before conducting the tests and perform the tests to the satisfaction and in the presence of their representatives. Tests are not to be considered finalized unless properly witnessed.
- .2 Test sprinkler systems in accordance with the requirements of the National Fire Protection Association (NFPA 13) latest issue.
- .3 Prior to submittal for building occupancy permit, furnish and pay for a Certificate of Approval showing that the complete job is in accordance with the rules and regulations of National Fire Protection Association. Include in Operating and Maintenance Manuals.
- .4 Notify the Consultant in writing at least forty-eight (48) hours prior to start of test. failure to do so may require tests to be re-done.
- .5 Pressure test sprinkler piping with 200 psig (1380 kPa) cold water for not less than four (4) hours without decrease in pressure.
- .6 Perform tests on concealed piping before concealing in structure. Protect equipment and parts not capable of withstanding test pressure during tests.
- .7 Make leaks tight while systems are still under test. If this is impossible, remove and re-fit defective parts. Caulking of threaded joints or welds will not be permitted.
- .8 After leaks have been repaired, repeat tests as often as necessary ensure tightness of each system.
- .9 Test jockey pump in presence of local Fire Department and Consultant.
- .10 The Contractor is to provide two (2) copies of testing data, reports and final acceptance from the representative of the local Fire Department and submit the results to the Consultant.

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3.3 Instructions To Operator

- .1 Instruct Owner's Building Operator in care, maintenance and operation of Sprinkler System and associated equipment.
- .2 Provide a typewritten description of care, maintenance and operation of the systems in a three-ring binder.

3.4 Final Inspection

- .1 Arrange for the completed installation to be inspected by the Municipal Fire Department and present to the Architect, four (4) copies of Certificate or Letter of Approval.

3.5 Guarantee

- .1 Furnish to the Owner through General Contractor and Architect, a written guarantee covering materials and workmanship and free service as per General Conditions.
- .2 Guarantee shall entail the repair and replacement of materials without charge to the Owner except, where in the opinion of the Architect, such repair or replacement was caused by improper use or lack of maintenance during the guarantee period.

3.6 Seismic Bracing

- .1 Refer to Section 15010.

3.7 Protective Cages

- .1 Exposed sprinkler heads in Mechanical Room shall have protective cages.

3.8 As-Built Drawings

- .1 The As-Built Sprinkler Drawings must be submitted on AutoCAD disk. Drawings shall indicate pipe routing and final sprinkler head locations. The Consultant will provide to the Sprinkler Contractor, a disk with Drawings of the floor plans and reflected ceiling plan, in CAD format. Contractor shall sign a "Transfer of Electronic Media" form and pay a fee before receiving electronic format documents. See Section 15010.

3.9 Identification Signs

- .1 Provide each control valve, shut-off valve, drain valve and test valve with a sign. Size of sign shall be 6" x 6" (150 mm x 150 mm) for automatic control valves and alarm valves and 2" x 6" (50 mm x 150 mm) for other valves. Inscription shall be in accordance with Canadian Underwriters' Association standards. Sign shall be made of enamelled steel with Fire Department "RED" enamel background, white enamel letters and shall be fastened in a workmanlike manner to the pipe or structure in the immediate vicinity of the valve identified.
- .2 Signs chained to valves are not acceptable.

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.

1.2 Quality Assurance

- .1 Install, test and have inspected all Work in accordance with the requirements of the latest edition including Amendments of the Ontario Building Code; National Fire Protection Association (NFPA 10); the local authorities having jurisdiction; and The Ontario Fire Code.
- .2 All materials - CSA, ULC and HEPC of Ontario approved for the intended applications.

1.3 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 - Submittals for the following equipment:
 - .1 Fire extinguishers and cabinets.

PART 2 - PRODUCTS

2.1 Fire Extinguishers

- .1 Provide where identified, 5 lb. (2.27 kg) extinguishers with a rating of 3A-10BC complete with a wall bracket for exposed installations.
 - .1 Designated FE
- .2 Acceptable Manufacturers:
 - .1 Impaction Fire Equipment Ltd.
 - .2 Chubb Fire Security
 - .3 National Fire Equipment
 - .4 Wilson & Cousins
 - .5 Williams Brothers

PART 3 - EXECUTION

3.1 Fire Extinguishers & Cabinets

- .1 **Extinguishers - Designated FE:**
 - .1 Install units where shown, fully charged and free of any defects.
 - .2 Install the extinguishers immediately prior to Substantial Performance inspection and be responsible for their security until the building has been accepted.
- .2 **Cabinets - Designated FEC:**
 - .1 Turn over cabinets to the block layer for installation within block walls, fasten to framing Provided by others in metal stud partitions. Mount flush with wall.
 - .2 Mount cabinets 5'-0" (1500 mm) above finished floor to top of cabinet.

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.3 Wall Hangers:

- .1 Mount hangers securely to wall so that top of extinguisher is 5'-0" (1500 mm) above finished floor.

.4 General:

- .1 Comply with the requirements of the National Fire Protection Association (NFPA 10), the Ontario Building Code (OBC) and the Ontario Fire Code.

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PART 1 - GENERAL

1.1 Requirements Included

- .1 Conform to the General Provisions of Section 15010.

1.2 Related Work Specified Elsewhere

- .1 Basic Materials & Methods Section 15050
- .2 Controls & Instrumentation Section 15900
- .3 Electrical Work Division 16

1.3 Quality Assurance

- .1 Conform the latest edition, including Amendments of the following Codes and Standards.
- .2 O. Reg. 225/01, Ontario Gas Utilization Code
- .3 ASHRAE 90.1 as modified by Ontario Hydro Supplement.
- .4 Regulations of CSA Standard B139.09, current edition, Installation For Oil Burning Equipment.

1.4 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 for the following equipment:
 - .1 Heating Boilers

PART 2 - PRODUCTS

2.1 Heating Boiler - DESIGNATED B-1

- .1 The BOILER shall be a LOCHINVAR KNIGHT Model KHB285 having a modulating input rating of 285,000 Btu/Hr, an output of 264,000 Btu/Hr and shall be operated on Natural Gas. The BOILER shall be capable of following performance:
- .2 The BOILER shall bear the ASME "H" stamp for 80 psi working pressure and shall be National Board listed. The BOILER shall have a fully welded, stainless steel, fire tube heat exchanger. There shall be no banding material, bolts, gaskets or "O" rings in the pressure vessel construction. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. The condensate collection basin shall be constructed of welded stainless steel. The complete heat exchanger assembly shall carry a fifteen (15) year limited warranty.
- .3 The heat exchanger shall have a volume of water no less than For models KHB285 / WHB285, 4.9 gallons
- .4 The BOILER shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.13 test standard. The BOILER shall operate at a minimum of 95% AFUE Efficiency (KHB/WHB055-285) and 94.4% THERMAL Efficiency (WHB399) as registered with AHRI. The BOILER shall be certified for indoor installation.

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- .5 The BOILER shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided for observing the burner flame and combustion chamber. The burner shall be a premix design constructed of high temperature stainless steel with a woven Fecralloy outer covering to provide smooth operation at all modulating firing rates. The BOILER shall be supplied with a negative pressure regulation gas valve and be equipped with a pulse width modulation blower system to precisely control the fuel/air mixture to the burner. The BOILER shall operate in a safe condition with gas supply pressures as low as 4 inches of water column. The burner flame shall be ignited by direct spark ignition with flame monitoring via a flame sensor.
- .6 The BOILER shall utilize a 24 VAC control circuit and components. The control system shall have a factory installed display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The BOILER shall be equipped with a temperature/pressure gauge; high limit temperature control with manual reset; ASME certified pressure relief valve set for 30 psi (standard); outlet water temperature sensor with a dual thermistor to verify accuracy; system supply water temperature sensor; outdoor air sensor, flue temperature sensor with dual thermistor to verify accuracy; low water cut off with manual reset, blocked drain switch and a condensate trap for the heat exchanger condensate drain.
- .7 The BOILER shall feature the "SMART SYSTEM™" control which is standard and factory installed with 128 x 128 resolution display, password security, outdoor air reset, pump delay with freeze protection, pump exercise, ramp delay featuring six steps, domestic hot water prioritization with limiting capabilities, USB drive for simple uploading of parameters and a PC port connection for connection to a local computer for programming and trending. A secondary operating control that is field mounted outside or inside the appliance is not acceptable. The BOILER shall have alarm contacts for any failure, runtime contacts and data logging of runtime at given modulation rates, ignition attempts and ignition failures. The BOILER shall have a built-in "Cascade" with leader redundancy to sequence and rotate while maintaining modulation of up to eight boilers of different BTU inputs without utilization of an external controller. The internal "Cascade" function shall be capable of lead-lag, efficiency optimization, front-end loading, and rotation of lead boiler every 24 hours. The BOILER shall be capable of remote communication via optional CON-X-US™ Remote Connectivity with the capability of historical trending and sending text message or email alerts to notify the caretaker of a boiler alarm and remote programming of onboard boiler control. The control must have optional capability to communicate via Modbus protocol with a minimum of 46 readable points. The BOILER shall have an optional gateway device which will allow integration with LON or BACnet protocols.
- .8 The "SMART SYSTEM™" control shall increase fan speed to boost flame signal when a weak flame signal is detected during normal operation. A 0-10 VDC output signal shall control a variable speed boiler pump (pump shall be supplied by manufacturer) to keep a fixed Delta T across the boiler regardless of the modulation rate. The BOILER shall have the capability to receive a 0-10 VDC input signal from a variable speed system pump to anticipate changes in system heat load in order to prevent flow related issues such as erratic temperature cycling.

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- .9 The BOILER shall be equipped with two terminal strips for electrical connection. A low voltage connection board with 46 connection points for safety and operating controls, i.e., Alarm Contacts, Runtime Contacts, Low Water Cut Off, Louver Proving Switch, Tank Thermostat, Domestic Hot Water Building Recirculation Pump Contacts, Domestic Hot Water Building Recirculation Temperature Sensor Contacts, Remote Enable/Disable, System Supply Temperature Sensor, Outdoor Temperature Sensor, Tank Temperature Sensor, Modbus Building Management System Signal and Cascade Control Circuit. A high voltage terminal strip shall be provided for Supply voltage. Supply voltage shall be 120 volt / 60 hertz / single phase on all models. The high voltage terminal strip plus integral relays are provided for independent pump control of the System pump, and the Boiler pump.
- .10 The BOILER shall be installed and vented with a Direct Vent system with horizontal sidewall termination of both the exhaust vent and combustion air. The flue shall be Category IV approved material constructed of PVC, CPVC, Polypropylene or Stainless Steel. A separate pipe shall supply combustion air directly to the boiler from the outside. The boiler's total combined air intake length shall not exceed 100 equivalent feet. The boiler's total combined exhaust venting length shall not exceed 100 equivalent feet.
- .11 The BOILER shall have an independent laboratory rating for Oxides of Nitrogen (NOx) to meet the requirements of South Coast Air Quality Management District in Southern California and the requirements of Texas Commission on Environmental Quality. The manufacturer shall verify proper operation of the burner, all controls and the integrity of the heat exchanger by connection to water and venting for a factory fire test prior to shipping.
- .12 The BOILER shall operate at altitudes up to 4,500 feet above sea level without additional parts or adjustments. The BOILER shall be certified for operation at elevations of 4,500 feet, and above, by a 3rd party organization.
- .13 The BOILER shall be suitable for use with polypropylene glycol up to a 50% concentration. The de-rate associated with the glycol will vary per glycol manufacturer.
- .14 **Standard Construction**
 - .1 The BOILER shall be constructed in accordance with the following code requirements as standard equipment. Manufacturing of special models to meet the below code requirements is not acceptable.
 - .1 California Code (Except 285-399)
 - .2 Massachusetts Code
 - .3 Kentucky Code
 - .4 CRN Approval in Canada
 - .2 Note: Due to the large disparity in CSD-1 interpretation from state to state, please confirm to the factory all controls required in your jurisdiction.
- .15 Design is based on Lochinvar
- .16 Acceptable Products:
 - .1 Lochinvar
 - .2 A.O. Smith
 - .3 RBI

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PART 3 - EXECUTION

3.1 Hydronic Heating Boilers

- .1 Install boiler in accordance with Manufacturers instructions and make all necessary piping and vent connections in accordance with Ontario Gas Utilization Code.
- .2 Division 16 to Provide power supply to boiler(s) and primary circulation pumps.
- .3 Upon completion of the installation the boiler Manufacturer to furnish the services of a technician to start up boilers and perform combustion tests over their full operating range.
- .4 Boiler shall be wall mounted using the provided wall mounting kit including bracket.
- .5 Refer to Section 15900 for boiler sequence of operation.
- .6 Demonstrate boiler operation to the Commissioning Agent.
- .7 Submit start-up report to Commissioning Agent and Consultant.

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Liquid Heat Transfer

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.

1.2 Quality Assurance

- .1 Conform the latest edition, including Amendments of the following Codes and Standards.
- .2 ASHRAE 90.1.
- .3 Local and district by-laws, regulations and published engineering standards.
- .4 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 332/12 including all amendments.

1.3 Related Work Specified Elsewhere

.1	Basic Materials & Methods	Section 15050
.2	Insulation	Section 15180
.3	Air Distribution	Section 15800
.4	Controls & Instrumentation	Section 15900
.5	Refrigeration	Section 15950
.6	Electrical Work	Division 16

1.4 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 - Submittals, for the following equipment:
 - .1 Cabinet Heating Units
 - .2 Convectors
 - .3 Radiant Heating Ceiling Panels

PART 2 - PRODUCTS

2.1 Hydronic Specialties

- .1 **Cold Water Make-Up:** Each station to include shut-off valve, backflow preventer (with drain cup piped to nearest floor drain), shut-off valve, strainer, union, pressure reducing valve, pressure gauge, union, stop valve and by-pass connection with globe valve.
- .2 **Safety Relief Valve:**
 - .1 ASME rated pressure and temperature relief valve automatic reseating type with test lever sized for full BTU rating of equipment.
 - .2 Acceptable Products:
 - .1 Watts
 - .2 S.A. Armstrong
 - .3 Bell & Gossett

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2.2 Terminal Units

.1 General:

- .1 All terminal units shall have element lengths and capacities as indicated on Drawings. Capacities shall be based on 180°F (82.2°C) entering and 160°F (71.1°C) leaving water temperature, and 60°F (18.3°C) entering air temperature.
- .2 All heating elements shall be aluminum fins mechanically bonded to seamless copper tubing.
- .3 All terminal heat transfer units shall be treated to multi-step preparation before the addition of an electrostatically applied powder coat paint finish, colour chosen from Manufacturer's standard colours.
- .4 All finned tube radiation components shall be cleaned and phosphatized to prevent corrosion.
- .5 Provide for noiseless expansion of all components.

.2 Wall Fin Convection Radiation - DESIGNATED EF-1:

- .1 Copper-Aluminum Element - Tubing shall be 1-1/4" (32 mm) nominal I.D. (1-3/8" (35 mm) O.D.) or 3/4" (19 mm) seamless copper. Fins shall be aluminum 4-1/4" x 4" (108 mm x 102 mm), 0.016" (0.4 mm) thick with a stamped pattern for strength and rigidity. They shall have integral collars to provide even spacing and maximum heat transfer. Fins shall be firmly bonded to the tube by mechanical expansion. All copper-aluminum elements shall have 49 fins/ft. (164 fins/m). Tube ends shall be suitable for connecting with sweat fittings.
- .2 Enclosures - Enclosures shall be constructed of 18 gauge premium cold rolled steel. The enclosures shall be supported at the top by a 1/2" (13 mm) joggle strip mounted on wall and at bottom by support brackets which shall be wall mounted on not more than 3'-0" (1.0 meter) centres. Enclosures shall have factory installed gusset plates to maintain enclosure shape during shipment and installation. Gusset plates shall be welded to enclosure.
- .3 Element Brackets - Element brackets shall consist of a steel cradle mounted on a lexan slide plate which will allow free and quiet element expansion. Element brackets shall be securely fastened to wall brackets on not more than 4'-0" (1200 mm) centres.
- .4 Accessories - Provide all necessary filler pieces, end caps, etc. as required, refer to Drawings.
- .5 Acceptable Products:
 - .1 Trane
 - .2 Engineered Air
 - .3 Sigma

.3 Cabinet Unit Heaters - DESIGNATED CH-1, CH-2:

- .1 Cabinet unit heaters shall be CSA approved and bear the CSA label.
- .2 Casings shall be fabricated with minimum 16 gauge premium cold-rolled steel. Casing shall have 1/2" (13 mm) thick dual density glass fibre insulation and removable front access panel. The casing shall incorporate an integral piping pocket, and hinged access door to electrical junction box. Recessed models to be furnished with a recessing frame.

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- .3 The coil shall consist of aluminum fins mechanically bonded to copper tubes. Fins shall be rippled for maximum heat transfer and coil casing shall be of satin coat sheet metal. Headers shall be Provided with copper sweat pipe connections easily accessible in piping pocket. Prior to installation in the cabinet heater, the coil shall be factory tested with air at 300 psig (2069 kPa).
- .4 The cabinet heater shall be Provided with centrifugal forward curved, double width, double inlet, precision formed steel fan wheels which have been dynamically balanced and directly connected to the motor shaft.
- .5 All motors shall be three speed, open type, resiliently mounted incorporating sleeve bearing and with integral thermal overload protection. Motors shall be securely mounted to a housing mounting panel.
- .6 Units shall have integral free-flow steel grilles stamped at a 15 degree angle.
- .7 Units shall be complete with 3/8" (9.5 mm) aluminum washable filters.
- .8 Unit capacities and model type shall be as indicated on Drawings.
- .9 Unit shall be complete with built-in thermostat and variable speed or 3-speed fan control.
- .10 Acceptable Products:
 - .1 Trane
 - .2 Engineered Air
 - .3 Modine

2.3 Linear Radiant Ceiling Panels - DESIGNATED RP

- .1 Panels shall be manufactured by a company regularly engaged in the manufacture of radiant panels and having catalogue performance data and certified test data.
- .2 Contractor shall refer take field measurements of existing ceiling tile grid in addition to referring to Mechanical Drawings to determine location, quantity and finish of radiant panels.
- .3 Panels shall run continuously in existing ceiling tile grid, and specified widths are minimum allowable.
- .4 The radiant ceiling extrusions shall consist of extruded aluminum with copper tubing of 0.504" (12.8 mm) I.D. mechanically attached to the aluminum face plate. The copper tubes shall be held in place by an aluminum saddle which extends more than halfway around the diameter of the tube. A non-hardening heat conductive paste shall be placed between the copper tubing and the aluminum face plate. Panels shall weigh no more than 2.15 lbs/ft² (10.5 kg/m²) when operating. The use of adhesive and/or clips to attach the copper tube to the extrusion will not be acceptable.
- .5 Panels shall be finished in the Manufacturer's standard white colour.
- .6 Output based on panels at 170°F (76.6°C) average water temperature, with 70°F (21°C) ambient air temperature and 67°F (19.4°C) AUST with natural convection. Refer to Drawings for panel widths and number of heating tubes.
- .7 Acceptable Products:
 - .1 Sigma
 - .2 Airtex
 - .3 Airtite

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PART 3 - EXECUTION

3.1 Terminal Units

.1 Wallfin Radiation:

- .1 Mounting heights of wall mounted units shall be as recommended by the Manufacturer and shall be closely co-ordinated with all other trades to avoid interferences.
- .2 Support terminal units from structural elements of wall, and not from wall finishes.
- .3 Comply with Manufacturer's installation instructions.
- .4 Provide 12" (305 mm) wide section of removable enclosure at each end for valve access.

.2 Cabinet Heaters:

- .1 Comply with Manufacturer's installation instructions.
- .2 Mount cabinet heaters from structural elements of wall.
- .3 Division 16 to Provide power to unit with suitable disconnecting device.
- .4 Integral thermostat to cycle fan on a call for heat.

3.2 Linear Radiant Panels

- .1 The Contractor to co-operate with other trades working in the ceiling to achieve a neat, well co-ordinated overall installation. Refer to Architectural and Mechanical Details for installation requirements.
- .2 All interconnecting of radiant panels by the Mechanical Contractor shall consist of 1/2" (15 mm) O.D. soft copper tubing or Airtex accessories as recommended by Manufacturer, i.e. factory supplied 360 deg. inter-connecting loops and 180 deg. return U-bends. Supply first to panel tubing pass closest to perimeter wall. Multiple panels shall be circuited to ensure serpentine flow over complete length of zone. Individual serpentine panel coils connected in series in unacceptable for multiple panel zones.
- .3 All radiant panels shall run continuous from wall-to-wall and shall be field trimmed to length ensuing adequate expansion allowance while maintaining panel end coverage by architectural mouldings. Inactive filler panels will be permitted only where indicated on Drawings.
- .4 Ceiling support mouldings for Radiant Panels to be supplied and installed by Division 15. Ensure ceiling openings and wall mouldings are installed per radiant panel Shop Drawings.
- .5 All radiant panels shall be installed by personnel wearing clean white gloves, to avoid soiling of panel face. Hanger wires for safety and seismic restraint shall be installed at 4'-0" (1200 mm) o.c. or as recommended by the Manufacturer.
- .6 All system piping shall be thoroughly cleaned, flushed, drained and refilled before radiant panels are connected into the system.
- .7 No installation of finished radiant panels shall begin until all glazing has been completed and all exterior openings closed in.
- .8 All active panels shall be covered with a minimum of 1" (25 mm) thick batt insulation.

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.

1.2 Related Work Specified Elsewhere

- .1 Basic Materials & Methods Section 15050
- .2 Air Distribution Section 15800
- .3 Electrical Work Division 16

1.3 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 - Submittals, for the following equipment:
 - .1 Air Separator
 - .2 Pump Suction and Discharge Valves
 - .3 Circuit Balancing Valves
 - .4 Expansion Tank
 - .5 Air Eliminator

PART 2 - PRODUCTS

2.1 Strainers

- .1 Supply and install strainers where shown on the Drawings. Strainer baskets shall be of stainless steel or monel selected for the service for which they are installed. Strainers 2" (50 mm) I.P.S. and smaller shall be screwed; 2-1/2" (65 mm) I.P.S. and larger shall be flanged or grooved ends. Flanged strainers shall be Provided with a blow-off ball valve, full size of blow-off tapping, with a short nipple on discharge side. Smaller strainers shall have nipple and cap affixed.
- .2 Strainer bodies for mechanical systems shall be cast iron or brass. Mueller #11 (C.I.), 351m (bronze) and 758 (C.I. Flanged).
- .3 Strainer bodies for plumbing systems shall be brass.
- .4 Acceptable Products:
 - .1 Colton
 - .2 Sarco
 - .3 Armstrong
 - .4 Mueller
 - .5 Watts

2.2 Air Eliminators

- .1 Air eliminators on hydronic chilled water and heating mains to be:
 - .1 Sarco
 - .2 S. A. Armstrong

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- .3 Colton
- .4 Amtrol
- .2 Air eliminators are to be connected to air collecting chambers with 1/2" (13 mm) I.P.S. nipple and isolating gate valve. Air collecting chambers shall consist of a full size tee.
- .3 Each unit to be complete with automatic air vent. Pipe up completely.
- .4 Air eliminator shall be insulated by Section 15180.

2.3 Air Separators

- .1 Supply and install as shown on Drawings an air separator with tangential nozzles. The air separator shall be fitted with an NPT vent connection to facilitate installation of piping to connect expansion tank or air vent to the air separator. An NPT tapping shall be Provided on the bottom of the air separator to facilitate blow-down.
- .2 The air separator shall be equipped with a steel system strainer with free area of not less than four times the cross-sectional area of the connecting pipe. Strainer can be removed for routine cleaning.
- .3 Air separators sizes 2" (50 mm), 2-1/2" (65 mm) and 3" (75 mm) will have cast iron body with NPT connections and will be designed and constructed for 160 psig (1100 kPa) at 350°F (177°C). Air separators 4" (100 mm) to 12" (305 mm) will be fabricated steel with flanged connections, sizes are to be designed and constructed for 165 psig (1140 kPa) at 375°F (190°C).
- .4 All sizes are to be designed and constructed in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code.
- .5 Air separators shall be insulated by Section 15180.
- .6 Acceptable Manufacturers:
 - .1 Amtrol
 - .2 Armstrong
 - .3 Bell & Gossett
 - .4 Taco

2.4 Pressure Gauges

- .1 To be 4-1/2" (115 mm) black cast aluminum case, black figures on white dial face, phosphor bronze tube, brass rotary movement, ranges to suit pressure of medium being measured, complete with needle valve. Provide pressure snubbers on pump suction and discharge.
- .2 Trerice series 600C, with type FFG - No. 740 needle valves and No. 872 snubbers.
- .3 Acceptable Products
 - .1 Trerice
 - .2 Winter
 - .3 Weiss
 - .4 Baker

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2.5 Temperature Gauges

- .1 To be 7" (175 mm) high, aluminum case, Bi-metal thermometer, solar powered, calibrated in both deg. F & deg. C to suit range of medium being measured. All thermometers to include separable well.
- .2 Base Bid: Trerice SX9
- .3 Alternate Products:
 - .1 Winters
 - .2 Baker
 - .3 Weiss

2.6 Expansion Joints

- .1 For steel pipe to be self equalizing type with two-ply stainless steel bellows, carbon steel shrouds and internal positive anti-torque device.
 - .1 Flexonics Model H or H3, or Hydro-Flex.
- .2 For copper pipe to be self equalizing type with two-ply bronze bellows, all bronze construction and internal positive anti-torque device.
 - .1 Flexonics model HB or HB3 or Hydro-Flex.

2.7 Flexible Connections

- .1 Provide flexible connectors with inner core or annularly corrugated stainless steel with an outer casing of two layers of braided high tensile steel. Hose to be complete with couplings and fittings of steel with threaded or flanged connections, depending on pipe size. Flexonics or Hydro-Flex.

2.8 Flow Switches

- .1 To be single pole, double throw paddle type, stainless steel bearings, monel bellows, paddle, corrosion resistant with screw adjustment equal to McDonnell Miller Model FS4-3.

2.9 Low Water Cut Off

- .1 To be heavy duty siphon bellows type, knife edged stainless steel bearings, heavy duty copper float and cast iron body, complete with automatic reset switch equal to McDonnell Miller Model 63.
- .2 Provide upper and lower Test N Check valves to permit testing of operation of low water cut-off equal to McDonnell Miller Model TC-4.

2.10 Air Vents

- .1 Automatic air vents shall be used in exposed areas where they can be obviously seen to be leaking. In concealed areas, ceiling spaces, etc., manual vents shall be used. All automatic vents to have pet cock before vent.
- .2 High points in the mains where air will accumulate shall be Provided with a 3/4" x 6" long (20 mm x 150 mm long) air chamber and an Armstrong No. 7 automatic air vent with overflow connector and isolating pet cock.

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- .3 Each bottom-fed convector, continuous convector, fan coil unit and cabinet heater shall have a manual air vent assembly consisting of a 3/4" x 6" long
- .4 (20 mm x 150 mm long) chamber and a flexible 1/4" (6 mm) air tube to a manual vent in the end panel or front face, or a rigid iron pipe to the outlet grille with a manual slot head screw.
- .5 Acceptable Products:
 - .1 Armstrong
 - .2 Braukman
 - .3 Amtrol
 - .4 ITT

2.11 Diaphragm-Type Expansion Tank - DESIGNATED EXP-A

- .1 Supply and install Amtrol replaceable bladder-type expansion tank. See Mechanical Drawings for tank size.
- .2 Tanks shall be welded steel, tested and stamped in accordance with Section VIII, Division 1 of the ASME Code for a working pressure of 125 psig (860 kPa), factory charged, field adjustable and 240°F (115°C). Precharge to the system pressure shown.
- .3 Tank shall be complete with an internal replaceable bladder.
- .4 Mount on the floor in location shown.
- .5 Acceptable Products:
 - .1 Amtrol
 - .2 Sarco
 - .3 Hamlet and Garneau
 - .4 Letrol
 - .5 Taco

2.12 Terminal Unit Valves

- .1 All radiators, convectors, radiant panels and coil-type heating units shall have shut-off valves on the supply branch at the unit. Valves 1-1/4" (32 mm) in diameter and larger, and for heating units without tapped ends, shall be Crane No. 440 and No. 365-1/2, or Milwaukee 148 and F-2885-M. Smaller radiator-type valves shall be Dahl No. 11042 wheel handle.
- .2 Balance Valves: All radiator, convectors and coil-type heating units shall have balance valves on the return branch pipe at the unit. Balance valves to 1-1/4" (32 mm) diameter for tapped end heating unit, shall be Dahl 13013. Larger valves shall be Crane No. 7 with No. 1 disc.
- .3 Drain Valves: All low points of heating units and system shall have hose bibb type drains for draining system, Dahl Model #2345 with cap and chain..

2.13 Circuit Balancing Valves - DESIGNATED CBV

- .1 Supply and install for each air handling unit heating coil, each new coil in constant volume reheat unit, each reheat coil, each chilled water and glycol coil, heat pump piping and as indicated on Drawings, Tour and Andersson Limited circuit balancing valves.

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- .2 Valve shall be installed in the main system return piping, return line from each coil, radiant panel and heat pump.
- .3 Supply one only, portable meter Model #CBI. Meter shall be turned over to Owner with balancing report on completion.
 - .1 TBV-S = solder 1/2" and 3/4" (15 and 20)
 - .2 STA-D = NPT 1/2" - 2" (15 - 50)
 - .3 STA-F = flanged 2-1/2" - 12" (65 - 300)
- .4 Shop Drawings shall state location, design flow rate and size to suit flow rate.
- .5 Acceptable Products:
 - .1 S.A. Armstrong
 - .2 Tour & Anderson
 - .3 Watts

PART 3 - EXECUTION

3.1 Valves & Accessories

- .1 Use valves of line size unless noted otherwise or being used for balancing purposes.
- .2 Provide isolating valves in each branch from the main line and where shown.
- .3 Provide isolating valves for all fixtures, appliances etc. including the following:
 - .1 On each branch serving more than three fixtures.
 - .2 At the base of each main riser.
 - .3 Note: Valves are not necessarily shown on the Drawings.
- .4 Unless indicated otherwise Provide radiation circuit balancing valves at each terminal unit and in locations where valve is to be used for regulating purposes. Ball valves are not acceptable for balancing purposes.
- .5 Provide 1/2" (13 mm) ball valve with cap and chain at any low point of the system not drainable through the main supply piping.
- .6 All valves are to be tagged and a chart showing location and equipment controlled to be turned over to the Owner upon completion of the job.
- .7 Escutcheon plates are to be installed at all walls and floors where pipes are exposed to view.
- .8 Install auto air vents at all high points in system.
- .9 Install drain cup at each backflow preventer vent and drain opening and pipe to nearest floor drain.
- .10 All insulated valves shall have extended necks or shafts where the thickness of the insulation interferes with the operating handle.

3.2 Temperature Gauges

- .1 Install temperature gauges in all locations noted.
- .2 Check range of temperature expected at each location and supply thermometer with range to suit.

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- .3 All temperature gauges to be installed in separable wells.

3.3 Pressure Gauges

- .1 Install pressure gauges in all locations noted and before and after each circulating pump.
- .2 Check range of pressures expected at each location and supply pressure gauge with range to suit.

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Pumps

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to the General Provisions, Section 15010.

1.2 Related Work Specified Elsewhere

- .1 Basic Materials & Methods Section 15050
- .2 Electric Motors Section 15054
- .3 Electrical Work Division 16

1.3 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 - Submittals for the following equipment:
 - .1 Circulating Pumps

PART 2 - PRODUCTS

2.1 General

- .1 Supply and install pumps of the size, type and capacity shown in the Pump Schedule on the Drawings.

2.2 Circulating Pumps - DESIGNATED CP

- .1 Pumps are to be designed for water temperature and working pressure scheduled.
- .2 Provide 1/4" (8 mm) tapping on each side of pump, for connection of pressure gauges.
- .3 Refer to Drawings for schedule of pumps.
- .4 The complete pumping unit is to be suitable for the service shown in the pump schedule and the Pump Manufacturer is to conduct running tests to verify the conditions of head and capacity specified.
- .5 Pump body to be cast iron, bronze fitted unless indicated otherwise, oil lubricated.
- .6 Domestic water pumps shall have a bronze body, bronze fitted construction.
- .7 All pump motors 1 HP (746W) and above to have high efficiency motors in accordance with ASHRAE 90.1.
- .8 Acceptable Products:
 - .1 Armstrong
 - .2 Bell & Gossett
 - .3 Taco
 - .4 Grundfos

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PART 3 - EXECUTION

3.1 Centrifugal Pumps

- .1 Provide centrifugal pumps where and as indicated and install the pumps in accordance with Manufacturer's installation instruction.
- .2 Ensure pumps are adequately supported and suitable vibration devices installed.
- .3 Division 16 to Provide power wiring and all necessary electrical power connections.
- .4 Make all necessary piping connections to pump.
- .5 Make all necessary requirements to allow removal of pump for servicing.
- .6 Grout bases of all base-mounted circulating pumps.

3.2 Replacement Seals

- .1 Supply and install in each of the in-line circulating pumps and vertical pumps, a new set of mechanical seals. These shall be installed after the cleaning and flushing operation but prior to the addition of the final chemical treatment.
- .2 If the seals removed are in good condition, they will be turned over to the Owner.

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Natural Gas Equipment

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to the General Provisions, Section 15010.

1.2 Related Work Specified Elsewhere

- .1 Basic Materials & Methods Section 15050
- .2 Electrical Work Division 16

1.3 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 for the following equipment:
 - .1 Gas Pressure Reducing Valve

PART 2 - PRODUCTS

2.1 Gas Pressure Reducing Valve Stations

- .1 **Designated GPRV-1:**
 - .1 Gas pressure reducing regulators shall be Canadian Meter Limited Series 1800 standard regulators 5 psig reduced to 7" W.C., 600 SCFH capacity.
- .2 Acceptable Products:
 - .1 Canadian Meter Limited
 - .2 Spence
 - .3 Fisher

PART 3 - EXECUTION

3.1 Gas Pressure Reducing Valve Stations

- .1 Label gas pipe as "5 lbs." and "7" W.C." before and after each station.

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Air Distribution - General Provisions

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to the General Provisions, Section 15010.

1.2 Quality Assurance

- .1 Conform the latest edition, including Amendments of the following Codes and Standards.
- .2 Local and district by-laws, regulations and published engineering standards.
- .3 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 332/12 including all amendments.
- .4 SMACNA Standards.
- .5 ASHRAE Recommendations.
- .6 ASHRAE 90.1.

1.3 Related Work Specified Elsewhere

.1	Painting Colour Coding	Division 9
.2	Basic Materials & Methods	Section 15050
.3	Insulation	Section 15180
.4	Plumbing & Drainage	Section 15400
.5	Controls & Instrumentation	Section 15900
.6	Electrical	Division 16

1.4 Submittals

- .1 Submit certificates indicating that all required testing has been successfully completed.

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Air Distribution - Duct Construction

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.
- .2 Conform to Air Distribution - General Provisions, Section 15800.

1.2 Quality Assurance

- .1 Conform the latest edition, including Amendments of the following Codes and Standards.
- .2 Local and district by-laws, regulations and published engineering standards.
- .3 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 332/12 including all amendments.
- .4 SMACNA Standards.
- .5 ASHRAE Recommendations.
- .6 ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 Rectangular Low Pressure Duct Materials

- .1 For the purpose of this specification low pressure ductwork is to be ducted for systems below 2" (500 Pa) static pressure. This includes all ductwork indicated on the Drawings with the exception of that indicated in other parts of this section. Duct shall be fabricated to SMACNA Duct Construction Standards, Section No. 1, and as follows:
 - .1 HVAC Duct Construction Standards - Metal and Flexible - latest edition.
 - .2 HVAC Duct Leakage Test Manual - latest edition.
- .2 Ductwork shall be constructed to withstand 1-1/2 times the working static pressure with a leakage rate of 5% maximum and designed to operate at 1-1/2" w.g. (373 pa) maximum pressure.
- .3 Fabricate ducts from smooth finish prime grade, new, open hearth, soft steel sheet, galvanized, conforming to manufacturer's standard thickness as specified herein.
- .4 All sides of ducts over 10" (254 mm) in either dimension, to have all sides cross-broken or beaded at 12" (300 mm) spacing, except area of the duct where outlets are to be installed.
- .5 Thickness & Reinforcing of Sheet Metal Ductwork, Material & Thickness:

Largest Duct Dimension	Steel Thickness Gauge (mm) Duct	Steel Thickness Gauge (mm) Slip	Aluminum Thickness Gauge (mm) Duct	Recommend Construction Transverse Joints Slip
Up to 12" (300 mm)	26 (0.551)	26 (0.551)	24	Flat drive cleat on side, flat S cleat on top and bottom. Joints on 96" (2440 mm) centres max.

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Largest Duct Dimension	Steel Thickness Gauge (mm) Duct	Steel Thickness Gauge (mm) Slip	Aluminum Thickness Gauge (mm) Duct	Recommend Construction Transverse Joints Slip
13" to 20" (330 mm to 508 mm)	24 (0.701)	26 (0.551)	22	Flat drive cleat on side, 1" (25 mm) standing S cleat on top and bottom. Joints on 72" (1819 mm) centres max.
21" to 30" (533 mm to 762 mm)	24 (0.701)	26 (0.551)	22	Flat drive cleat on sides up to 20" (508 mm), and 1" (25 mm) standing drive slip over 20" (508 mm). Top and bottom 1" (25 mm) standing S cleat. Joints on 48" (1219 mm) centres maximum.
31" to 48" (787 mm to 1219 mm)	22 (0.853)	22 (0.853)	20 (1.01)	Flat drive cleat on sides up to 20" (508 mm), and 1" (25 mm) standing drive slip up to 30" (762 mm), and 1" gasketted and bolted formed flange over 30". Top and bottom 1" (25 mm) standing S cleat. Joints on 48" (1219 mm) centres maximum. (* Stays if required.)
49" to 60" (1245 mm to 1529 mm)	20 (1.01)	20 (1.01)	18 (1.16)	Flat drive cleat on sides up to 20" (508 mm), and 1" (25 mm) standing drive slip up to 30" (762 mm), and 1" gasketted and bolted formed flange over 30". Top and bottom 1-1/2" (40 mm) gasketted and bolted formed flange. Joints on 48" (1219 mm) centres maximum.

- .6 The Contractor at his own discretion may also use flange duct joints; Ductmate or Nexus.
- .7 All bends or elbows shall be made with a radius of not less than 1-1/2 times the width of the duct. Where this is not possible, turning vanes shall be used. Vanes shall be of single vane construction with 1-1/2" (40 mm) space up to 24" (600 mm) width, and 3" (80 mm) spacing over 24" (600 mm).
- .8 Branch mains shall be connected to the main duct as specified for ductwork. "T" connection shall be made using a clinch lock.
- .9 Acoustical Liner: Ducts are to be increased in size by thickness of insulation added to maintain inside dimensions as per indicated duct sizes and to ensure no increase in duct design velocity.

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2.2 Circular Duct & Fittings, Single-Wall

- .1 For the purpose of this specification low pressure ductwork is to be ducted for systems below 2" (500 Pa) static pressure. This includes all ductwork indicated on the Drawings with the exception of that indicated in other parts of this section. Duct shall be fabricated to SMACNA Duct Construction Standards Section No. 1 (latest edition).
- .2 All round duct through 26" (660 mm) diameter shall be United Sheet Metal Spiral lock-seam Uni-Seal duct manufactured from galvanized steel meeting ASTM A-527-71 in the following gauges:

Diameter	Metal Thickness	
3" - 7" (76 - 175 mm)	28 ga.	0.01" (0.40 mm)
8" - 14" (203 - 350 mm)	26 ga.	0.022" (0.551 mm)
15" - 26" (381 - 660 mm)	24 ga.	0.028" (0.701 mm)
27" - 35" (685 - 875 mm)	22 ga.	0.022" (0.851 mm)
36" - 52" (900 - 1325 mm)	20 ga.	0.016" (1.0 mm)

- .3 All fittings shall be United Sheet Metal standard Uni-Form fittings manufactured from galvanized steel meeting ASTM A-527-71 with continuous weld or standing seam construction with fitting gauge and thickness equal to or thicker than the downstream duct section with which they are mated.
- .4 All 90 degree T Connections shall have machine formed radiused entrances (laminar flow) on tees to 16" (406 mm) diameter taps off of 18" (457 mm) diameter bodies and machine-rolled (pull-through) entrances on tees to 24" (600 mm) diameter taps off of 24" (600 mm) diameter bodies.
- .5 All 45 degree laterals shall have machine rolled (pull through) entrances on laterals to 12" (300 mm) diameter taps.
- .6 Elbows shall be fabricated to a centre-line radius of 1.5 times the cross-section diameter.
- .7 Sleeve couplings to be used for pipe-to-pipe joints. Insertion length of sleeve couplings and fitting collar shall be 2" (50 mm) for ducts up to 9" (225 mm) diameter and 4" (100 mm) for ducts 10" (250 mm) and over in diameter.
- .8 Longitudinal joints shall be lapped and pressure rolled air tight. All seams, end joints and fittings are to be sealed with duct sealer. Duct sealer to be "United" duct sealer, 3-M, Tough Bond or Duro Dyne S-2.
- .9 All elbows, not die-stamped, shall be fabricated according to the following schedule:

Elbow Angle	Number of Gores
Less than 35 deg.	2
36 deg. through 71 deg.	3
Over 71 deg.	5

2.3 Flexible Duct

- .1 Flexible duct shall be pre-insulated acoustic type complete with perforated aluminum core, 1" (25 mm) insulation and outer mylar sleeve.

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- .2 The flexible duct shall be rated for a maximum working velocity of 2500 FPM (12.7 m/s) and 4" (1500 Pa) W.C. pressure and be listed by Underwriters Laboratories under their UL-181 Standards as Class I, Air Duct and shall comply with NFPA Standard No. 90A.
- .3 Flexible duct shall be maximum 6'-0" (1800 mm) and minimum 3'-0" (900 mm). Install with a minimum number of bends.
- .4 Connection to branch ducts shall be made with spin-in collars. Joints shall be sealed duct type and secured to the duct with metal screw-type bands. Spin-on collars shall be complete with balancing damper.
- .5 Flexible ductwork sizes shall match diffuser neck size.
- .6 Design based on Flexmaster Nova Flex Group - Type T/L-A
- .7 Acceptable Products:
 - .1 Alpha-Flex
 - .2 Cana-Flex
 - .3 Automation Industries
 - .4 Nova Flex Group - Flexmaster

2.4 Duct/Plenum Protective Edge

- .1 Supply and install on all edges a pre-formed, galvanized 1-1/2" x 1-1/2" (40 mm x 40 mm) x 16 gauge, 90 degree protective edge.
- .2 Protective edges to be installed after insulation has been applied and before canvas covering.
- .3 See Duct Insulation.

2.5 Hangers

- .1 Horizontal ductwork up to 29" (740 mm) wide shall be supported by galvanized 1" (25 mm) 16 gauge or heavier hangers placed not over 6'-0" (1800 mm) apart, with ends turned under the duct. Secure to duct with sheet metal screws, two (2) per side, and one (1) in bottom.
- .2 Horizontal ductwork 30" (760 mm) wide and over shall rest on galvanized angle iron supports or Unistrut channels, with rod hangers at 6'-0" (1800 mm) spacing as follows:

Duct Size	Rod	Angle
30" to 48" (750 mm to 1200 mm)	1/4" (6 mm)	1-1/2" x 1-1/2" x 1/8" (40 mm x 40 mm x 3 mm)
49" to 72" (1225 mm to 1825 mm)	3/8" (9 mm)	1-1/2" x 1-1/2" x 1/8" (40 mm x 40 mm x 3 mm)
73" to 84" (1850 mm to 2130 mm)	3/8" (9 mm)	1-5/8" x 1-5/8" x 3/16" (45 mm x 45 mm x 5 mm)

- .3 Flexible duct shall be hung as per horizontal ductwork up to 29" (740 mm) wide.

2.6 Duct Sealing

- .1 All duct joints shall be sealed during manufacture with high velocity sealer, equal to Baker Duct-Seal or Duro Dyne DWN high velocity sealer and on the faces of the joints after cleats are installed.

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.2 DUCT TAPE IS NOT ACCEPTABLE.

PART 3 - EXECUTION

3.1 Duct Installation - General

- .1 In general, all ducts to be constructed that they may be dismantled and cleaned. All visible internal portions of duct outlets behind grilles and registers to be painted dull black.
- .2 Before installing ductwork, registers, grilles and diffusers, this Contractor shall check for interference with the work of others, so that grouped ducts, pipes and conduits will not interfere with each other, and that registers, grilles and diffusers are correctly located. See Architect's Reflected Ceiling Plans for final location of grilles, diffusers and sprinkler heads. Prepare interference Drawings as described in Section 15010 before fabricating ductwork. **DO NOT USE FLEXIBLE DUCT IN ROOMS WITH NO CEILING.**
- .3 Install ductwork essentially as shown, in strict adherence to the ceiling heights indicated on the Architectural Drawings. Architect reserves the right to vary run and shape of ducts and make offsets during the progress of the work as required, to avoid structural or other interferences.
- .4 Ductwork concealed in building construction shall be installed in time so as not to cause delay to the work of other trades, and in ample time to perform tests as required. Concealed ducts shall not be built-in until approval for them has been obtained from the Consultant. Make sheet metal connections to masonry as required for air inlets and exhaust, airtight and weathertight.
- .5 Prepare Shop Drawings, dimensions and locating wall, floor and roof slab openings in ample time to meet the building construction schedule. Field check and approve the size and locations of openings prior to placement of concrete or masonry. Openings required at a later date shall be at this Contractor's expense.
- .6 Interference Drawings shall be provided when the Contractor is supplying alternate equipment in lieu of the specified items in areas shown as Mechanical and Boiler Rooms, etc. He shall provide dimensioned Drawings of the equipment location, showing clearances to walls, ceiling, ducts etc., and also indicate clearances for filter and coil removal etc.

3.2 Ductwork

- .1 Supply and install ductwork and plenums shown and required to complete duct systems and put each in operating condition. Mechanical Drawings indicate general location and route of ductwork to be installed. General layout of ducts may be taken from Drawings, but this Section is responsible for avoiding interferences with other Sections not specifically shown on Mechanical Drawings. Actual measurements shall be taken at building before ductwork is fabricated.
- .2 Make without additional charge, any necessary changes or additions to layout of ductwork to accommodate structural, duct, piping, ceilings, electrical or equipment conditions. Where openings in walls for ductwork have been Provided by others, make full use of such openings by fabricating ductwork to fit them, or if necessary, Provide offsets and transitions to suit. Location of ducts may be altered if change is made before installation is approved by the Consultant, and does not cause Owner or other Sections any extra expense.

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- .3 Install in ductwork where shown or required, controls, motorized dampers, coils, filters, fire dampers, etc., in accordance with installation instructions supplied by Equipment Supplier.
- .4 Supply and install where required to suit system balancing, Lawson-Taylor Pitot Tube openings covers in ductwork for each supply, return and exhaust system. Provide openings at all supply fan discharges and exhaust fan inlets. Locate 15 mm (1/2") openings in straight duct runs to facilitate entry of pitot tube. Provide a minimum of three (3) holes per duct at each of the above locations, and at not more than 18" (450 mm) centres. Openings shall be concealed after tests by this Division.
- .5 After final adjustments are made for air handling systems, lock each control device in position and visually indicate required setting. For balancing dampers, Provide additional locking screw or bolt to approval.
- .6 During construction, temporarily seal open ends of ductwork to exclude entry of foreign material and construction dust.
- .7 Supply and install fire rated smoke sealant in gap between sheetmetal duct wall and finished wall.

3.3 Hangers

- .1 Low pressure ductwork shall have substantial hangers attached to the structure with concrete inserts to secure the ducts in place and prevent vibration. No caddy clips or plumber's tape permitted for hanging ducts. DO NOT SUPPORT FROM METAL DECK.

3.4 Quiet Operation

- .1 Each system has been designed to be quiet in operation, N.C. 35 maximum. It is the responsibility of this Section to supply equipment and to install same, ductwork, etc., to ensure noise levels will be maintained to the satisfaction of the Consultant.

3.5 Ductwork Construction

- .1 Ducts up to 24" (600 mm) in either dimension to have reinforcing ribs, spaced not more than 8'-0" (2400 mm) apart.
- .2 Ducts over 24" (600 mm) in either dimension to have reinforcing ribs, spaced not more than 4'-0" (1200 mm) apart. Ducts shall have supplemental stiffening as required to prevent drumming and provide a structurally sound assembly.

3.6 Changes in Shape or Dimension

- .1 Slope requirements for transformations that either increase or decrease duct area to a minimum of 1:7.
- .2 The angle of transformation at connections to heaters or other equipment is not to exceed 30 degrees from a line parallel to the airflow on the approaching side of the equipment, and 45 degrees on the leaving side of the equipment. The angle of approach may be increased to meet space conditions when the transformation section is provided with vanes.

3.7 Changes In Direction

- .1 Changes in direction and shape shall be kept to the minimum, permitted by distribution requirements and building conditions. Turns to be made with these elbows as required in the following order of preference on all supply, return and exhaust ductwork.

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- .2 Unvaned elbow, throat radius 3/4 width of duct and full heel radius.
- .3 Elbows with inside radius less than 3/4 width of duct but not less than 3" (80 mm) and full heel radius and single thickness turning vanes
- .4 Square elbow with single thickness turning vanes spaced at 1-1/2" (40 mm) centres up to 24" (600 mm) duct and 3" (80 mm) centres over 24" (600 mm).

3.8 Balancing Dampers

- .1 Splitter or opposed blade dampers for adjustment of air distribution to respective branches to be located as indicated on Drawings, or as described in other parts of this specification.

3.9 Seams

- .1 Sections to be assembled with Pittsburgh lock or grooved longitudinal seams, fully closed for tightness and appearance.

3.10 Joints & Reinforcement

- .1 Duct sections to be jointed by flat "S" or Standing "S" cleats which conform to following general requirements:
 - .1 Ducts up to 18" (450 mm) in width to have flat "S" cleats on top and bottom and drive cleats on sides.
 - .2 Ducts over 18" (450 mm) width to have standing "S" cleat on top and bottom and drive cleat on sides.
 - .3 Where length of drive cleat exceeds 24" (600 mm), a standing "S" or standing "T" cleat to be used and corners taped for tightness.

3.11 Supporting of Ducts

- .1 All ducts to be adequately supported. For ducts up to 18" (457 mm) in width, hangers to be placed on not more than 8'-0" (2400 mm) centres; ducts 19" (475 mm) and above in width on not more than 48" (1200 mm) centres. Hangers to be placed plumb and present a neat appearance.
- .2 Hangers on ducts up to 36" (900 mm) in width to be constructed from galvanized band iron 1" x 16 gauge (25 mm x 1.6 mm). On ducts 37" (925 mm) and above in width, hangers to be constructed from galvanized iron angles not less than 1-1/2" x 1-1/2" x 1/8" (40 mm x 40 mm x 3 mm). Hangers to extend down the sides of the ducts to bottom of duct with angle bent around bottom for support. Fasten to duct with sheet metal screws on sides and bottom. Hangers on ducts to be of same material as ductwork. Supply and install high velocity sealant on all sheetmetal screws.
- .3 Hangers bands to extend the full depth of duct with bottom of hanger being toed in under duct. Hangers to be attached to the duct using not less than three rivets or metal screws. Supply and install high velocity sealant on all sheetmetal screws.
- .4 On reinforced concrete, all hangers for ductwork to be fastened to the concrete by Ram-Set studs or expansion shields and lag bolts.
- .5 Ducts cannot in any location, be supported from the furring, ceiling construction, piping, conduit or other ducts.
- .6 The use of perforated band iron for supporting of ducts is not permitted.

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3.12 Reinforcing of Sheet Metal

- .1 All ductwork 12" (300 mm) and over in either dimension to be cross broken except those to which internal rigid board insulation is applied. Where drive cleat is used, top and bottom corners to be caulked before cleat is turned over to make duct air tight.
- .2 All other joints to be caulked at all corners before and after joint is made to make duct completely air tight.
- .3 All standing "S" cleats referred to are to be machine made for purposes of extra reinforcing.
- .4 All longitudinal seams are to be Pittsburgh lock seam hammered over and made air tight.
- .5 Where a duct falls into certain maximum duct size classification the entire duct, sides top and bottom, is to be of the gauge specified.
- .6 Sheet metal screws to be used on sides of ducts where standing "S" cleat is used or reinforcing angle on 12" (300 mm) centres or minimum 2 screws per side.

3.13 Location of Outlets

- .1 The position of all outlets shown on the Drawings are approximate only and this Contractor is to check the location of all outlets with the Consultant and make such adjustments in position as are necessary to conform with architectural features, acoustic tile pattern, etc. and the outlets required by other trades without extra charge. Ceiling outlets and their assemblies to be constructed so that they fit the spacing and manufacture of the removable acoustic ceiling.

3.14 Outside Openings

- .1 Unless specifically noted otherwise, openings in the outside walls, roof, etc. to be left for this Contractor, where shown and required for fresh air intakes and exhausts.

3.15 Duct Access Doors

- .1 Install access doors to fire or other dampers, for service, inspection, any other normal maintenance requirements, and for cleanouts where required on specialty systems. Ensure that such access doors are of a size that equipment to be attended is accessible.
- .2 Install an access door on the upstream side of each duct mounted heating coil.

3.16 Supply, Return & Exhaust Fans

- .1 All connections to fans to be made utilizing canvas connections as specified under this Section.
- .2 All fan systems are to be equipped with all accessories indicated in schedule.
- .3 Refer to Section 15900 Controls and Instrumentation and Section 16700 Wiring for Mechanical Equipment, and co-ordinate work.

3.17 Curbs

- .1 All new prefabricated insulated roof curbs supplied by this Division. All curbs flashed by Roofing Contractor. Refer to details on Drawings.

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3.18 Motorized Dampers

- .1 Install all motorized dampers supplied by Section 15900 in all locations indicated on the Drawings and described in this specification, except those dampers supplied as part of a packaged unit.

3.19 Sealing of Ducts

- .1 Seal all seams and joints in all duct systems for an air-tight installation.
- .2 Duct sealer shall be high pressure, high velocity water based duct sealer. Apply sealer with either brush or caulking tube.
- .3 On exposed duct scheduled for painting, seal only with Product from caulking tube, taking care to maintain a neat, finished appearance to the duct.

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.
- .2 Conform to Air Distribution - General Provisions, Section 15800.

1.2 Quality Assurance

- .1 Conform to the latest edition, including Amendments of the following Codes and Standards.
- .2 Local and district by-laws, regulations and published engineering standards.
- .3 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 332/12 including all amendments.
- .4 SMACNA Standards.
- .5 ASHRAE Recommendations.
- .6 ASHRAE 90.1.

1.3 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 - Submittals for the following equipment:
 - .1 Fire Dampers
 - .2 Combination Smoke/Fire Dampers

PART 2 - PRODUCTS

2.1 Fan Duct Connections

- .1 **Regular Low Pressure Duct:** Provide flexible duct connectors Duro-Dyne "Durolon" woven glass fibre 24 oz. per sq. yd. (814 gm per sq.m), tensile strength of not less than 450 lb., coated both sides with Du Pont Hypalon, with 3" (80 mm) metal to 6" (150 mm) Durolon to 6" (150 mm) metal "Grip-Lok" duct connections.
- .2 **Stainless Steel Fume Exhaust Duct:** Provide flexible duct connectors Duro-Dyne "Neoprene" woven glass fibre 30 oz. per sq. yd. (1017 g per sq. m), tensile strength not less than 450 lbs., coated both sides with Polychloroprene, secured to ducts and fans with 1" x 0.12" (25 mm x 3 mm) SS type 316L flat bars or bands using type 316L SS screws or bolts at 4" (100 mm) intervals.

2.2 Splitters & Balancing Dampers

- .1 Splitters to be made of at least the same thickness metal as the duct (minimum thickness 20 ga. (1.006 mm). They are to be securely hinged at the air leaving edge, and made of two thicknesses so the entering edge presents a rounded surface to air flow. Minimum length of splitter is 12" (305 mm). Splitter length is 1-1/2 times the width of the smaller duct when duct width is from 8" to 24" (200 mm to 600 mm). Splitter length for duct widths greater than 24" (600 mm) is 1-1/4 times the width of the smaller duct.

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- .2 Splitters to be anchored at the air entering edge by a SRP-40 Duro Dyne fitting and a 1/8" (3 mm) adjustable rod that passes thru a Duro Dyne SRP-14 ball joint damper casting, on the outside of the duct.
- .3 Balancing dampers for round duct shall be blade style, constructed of 22 U.S. gauge (1.613 mm) thick steel, trimmed for a proper fit within the duct and securely mounted in the duct. Manufactured components such as Nailor 1890 series are considered equal.
- .4 Balancing dampers for square duct shall be multi-blade opposed blade balancing dampers, Nailor 1820 series or equal; 16 gauges galvanized steel blades mounted on 1/2" Celcon bearings in a 16 gauge galvanized frame.
- .5 All balancing dampers to be controlled manually and able to lock in place with damper quadrant or other suitable device. Damper rod end to be marked indicating blade position.
- .6 All dampers serving group Washroom Exhaust systems shall be stainless steel.

2.3 Fire Dampers - DESIGNATED FD

- .1 Fire dampers shall be manufactured, tested and labelled in accordance with CAN/ULC-S112, and to be ULC listed and labelled for 1-1/2 hour fire rating. Fire dampers are to meet all requirements of NFPA 90, NBC and OBC.
- .2 Fire dampers to be galvanized steel channel frame curtain type galvanized steel interlocking blades, minimum 22 gauge (0.853 mm) galvanized steel enclosure, and 165°F (70°C) fusible link standard. Fusible links for 135°F (57°C), 212°F (100°C), or 284°F (140°C) shall be Provided if indicated on Drawing as such.
- .3 Fire dampers for horizontal installation in vertical ductwork to be operated by a stainless steel closure spring and latch.
- .4 Fire damper configuration to be low resistance type B with blades located outside of the air stream (unless detailed otherwise) for rectangular ductwork, and type C for round or oval ductwork.
- .5 All fire dampers are to be DYNAMIC rated.
- .6 Fire damper serving ceiling diffuser (FSF) to be butterfly type blade complete with spring type fusible link and thermal resistant blank.
- .7 Acceptable Products:
 - .1 Ruskin
 - .2 Controlled Air
 - .3 Nailor

2.4 Combination Fire & Smoke Dampers

- .1 Fabricate to NFPA 90A and/or UL 555 as indicated.
- .2 Provide factory sleeve and collar for each damper.
- .3 Multiple Blade Dampers: Fabricate with 1.5 mm (16 ga) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 3.2 x 12.7 mm (1/8 x 1/2 inch) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 12.7 mm (1/2 inch) actuator shaft.

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- .4 Operators: UL listed and labelled spring return. Provide end switches to indicate damper position. Locate damper operator on interior exterior of duct and link to damper operating shaft.
- .5 Pneumatic type suitable for operation on 0-140 kPa (0-20 psig) instrument air.
- .6 Electric type suitable for 120 Volts, single phase, 60 Hz.
- .7 Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.
- .8 Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.
- .9 Electro Thermal Link: Fusible link melting at 74 degrees C (165 degrees F); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.5 Access Panels

- .1 Ductwork to be fabricated from 20 gauge (1.006 mm) galvanized steel, hinged to 20 gauge (1.006 mm) galvanized mounting frame complete with fastening devices and felt gasket. Doors in insulated ducts to be double panel construction with 1/2" (13 mm) rigid insulation between metal.
 - .1 Acceptable Products:
 - .1 Nailor
 - .2 Controlled Air
- .2 Finished walls and ceilings to be steel as manufactured by Le Hage, and to be as recommended by the Manufacturer for each particular installation.
- .3 Access panels in walls, shafts or ceilings having a fire rating or forming part of a fire rated assembly or fire separation to have ULC 1-1/2 hour B label equal to Le Hage L-1010 with cylinder lock and interior latch release.
 - .1 Acceptable Products:
 - .1 Acudor Acorn Ltd
 - .2 Nailor
 - .3 Mifab

2.6 Turning Vanes

- .1 Install small arc air foil vanes in ducts at elbows where centre-line radius is less than 1-1/4 times turning dimension of duct.
- .2 Square elbows with turning vanes equal to Duro Dyne single thickness vanes spaced at 1-1/2" (40 mm) centres up to 24" (600 mm) duct and 3" (80 mm) centres over 24" (600 mm).
- .3 Acceptable Products:
 - .1 Duro-Dyne "Duro Vane Rail"
 - .2 Hart & Cooley "Ducturn"

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2.7 Access Doors

.1 Mandoors:

- .1 Access doors in the size range of 12" x 12" (300 mm x 300 mm) to 24" x 24" (600 mm x 600 mm) to be constructed as per SMACNA Low Pressure Duct Standards - Fifth Edition - Fig. 2-14 (Page 2-17). Door Type "C".
- .2 Factory fabricated access doors equal to Ventlok stamped, hinged, insulated door with #100 latch will be accepted.
- .3 Note: Mandoors shall open against the air pressure to allow the air pressure to seal the door against the door sealing gasket
 - .1 Positive pressure duct - door opens inward
 - .2 Negative pressure duct - door opens outward

2.8 Acoustic Duct Liner

- .1 Liner shall be flexible, edge coated, tightly bonded, mat-faced and shall be made from lead free inorganic glass fibres bonded by a thermosetting resin.
- .2 Liner shall be 1" (25 mm) thick, 1.4 lb/ft³ (22 kg/m³) density, where designated on the Drawings by diagonal hatching or where specified.
- .3 Liner shall be treated so that the maximum flame spread rating is 25 or less and the smoke development is 50 or less according to local bylaws.

2.9 Round Spin-In/Spin-On Duct Collars Complete With Balancing Damper

- .1 **Spin-on Collar:** Round duct connection to rectangular duct:
 - .1 Type A: Complete with insulation guard for connect to duct with internal insulation.
 - .2 Type B: For connection to duct without internal insulation.
- .2 **Spin-on Collar:** Take-off connection from rectangular duct to round or flexible duct for air diffusers, troffers etc.
 - .1 Model 1801 (without damper)
 - .2 Model 1802 (with damper)
- .3 Design is based on Flexmaster (NovaFlex Group)
- .4 Acceptable Products:
 - .1 Ductmate Industries
 - .2 Flexmaster

2.10 Round Spin-In Duct Collars

- .1 **Spin-In Collar:** Take-off connection from rectangular duct to round or flexible duct for air diffusers, troffers etc.
 - .1 Model 1801 (without damper)
 - .2 Model 1802 (with damper)
- .2 Design based on Flexmaster

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2.11 Volume Extractor - DESIGNATED SD

- .1 Supply and install volume extractor, where on Drawings, equal to E.H. Price Model AE1S.

2.12 Filter Gauges

- .1 Supply and install across filter section of each indoor supply air unit, a Dwyer Minihelic II air filter gauge.

2.13 Fan Sheaves

- .1 Supply as requested by the Balancing Agency, replacement sheaves and fan belts for each supply, return, and exhaust fan blower as required during the system air balancing.
- .2 Replacement of sheaves and belts shall be by Division 15800 as requested by the Balancing Agency and Consultant.

2.14 Backdraft Dampers - DESIGNATED BDD

- .1 Supply and install backdraft dampers where indicated on the Drawings, as supplied by E. H. Price (Model BDD-2X) with angle frame for surface mounting and channel frame for in-duct mounting. Provide access door for access to duct mounted units.

2.15 Combination Fire & Smoke Dampers

- .1 Basis of Design Manufacturer: EH Price
- .2 Fabricate to NFPA 90A and/or UL 555 as indicated.
- .3 Provide factory sleeve and collar for each damper.
- .4 The FSD-3V-211/231 complete with sleeve series Combination Fire/Smoke Dampers have been designed and tested to exceed all UL, ULC and NFPA requirements for fire dampers as well as smoke dampers. They are intended for use where building codes call for the fire damper to also operate as a smoke damper.
- .5 UL 555 and ULC S112 listed and labeled as a 1 1/2 (FSD-3V-211) or 3 (FSD-3V-231) hour fire damper.
- .6 ULand ULC listed for both vertical and horizontal mountings.
- .7 UL 555S / ULC S112.1 listed and labelled as a Leakage Class I rated Smoke Damper with airflow in both directions. Class I provides for a maximum leakage of 8 cfm per sq. ft. at 4.0 inches static pressure.
- .8 Each combination fire-smoke damper shall be equipped with a factory installed heat responsive device rated to close the damper when the temperature at the damper reaches: 165 deg F.
- .9 Required Options:
 - .1 Heat Response Device: Damper shall be supplied with an automatic resettable/override release option: Model STO/R (single thermostat) to provide the fire fighter with complete discretionary control of smoke functions during a fire/smoke emergency.

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- .2 STO/R: The STO/R is reset from the outside of the damper sleeve, therefore requiring a visual inspection of the damper. By depressing a button on the outside of the sleeve an inspector can verify if the damper is fully operational. The STO/R is a multi-use heat responsive device. It is wired in series with the smoke detector therefore it is user friendly in most applications. When the smoke detector interrupts the current to the damper, the STO/R will not hinder the closing of the damper. The STO/R package includes blade indicator switches which allow for remote notification of damper blade position, as a standard feature. Electrical: 120V AC
- .3 Low Flow Smoke Detector: Dampers shall be provided with a Low flow smoke detector. The low flow smoke detector is required to provide proper damper operation in the smoke mode. Smoke detector to Photoelectric type with air velocity rating from 100 ft/min to 4,000 ft/min (0.5 m/s to 20.32 m/sec)
- .4 Smoke Detector Mounting: Shipped loose for field installation. Installed by Sheet metal Contractor.
- .5 Actuator: to be Spring return type damper motor, 2-position, electrical: 120V AC, listed for Fire/Smoke Dampers.
- .6 Momentary Test Switch: Dampers to be equipped with a momentary Test Switch, Model # DPS. DPS to be push button type with light. Electrical: 120V AC
- .10 Construction:
 - .1 Frame: Roll-formed galvanized steel hat section with staked corners with integral bracing.
 - .2 Blades: 16 ga. Roll-formed galvanized steel. Minimum width: 41/4" (108 mm) Maximum width: 71/4" (184 mm)
 - .3 Bearings: Bronze Oilite, press-fit into frame.
 - .4 Axles: Square, plated steel.
 - .5 Seals: Pressure sensitive 450°F silicone blade edge seals and flexible stainless steel compression type jamb seals.
 - .6 Linkage: Concealed in frame. Linkage bars are 12 ga galvanized steel.
 - .7 Finish: Mill galvanized.
 - .8 Spring: Stainless steel.
 - .9 Access Door: Field supplied and installed by Sheet metal contractor.
- .11 Factory Tests: Factory cycle damper and actuator assemblies to assure proper operation.

PART 3 - EXECUTION

3.1 Balancing Dampers

- .1 Splitter or opposed blade dampers for adjustment of air distribution to respective branches to be located as indicated on Drawings, or as described in other parts of this Specification.

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3.2 Duct Access Doors

- .1 Install removable access doors to fire dampers or other dampers, humidifier manifolds, heating coils (both sides), main ducts for cleaning purposes, for service, inspection, any other normal maintenance requirements, and for cleanouts where required on specialty systems. Ensure that such access doors are of a size that equipment to be attended is accessible.
- .2 Access doors are to be fully accessible.

3.3 Turning Vanes

- .1 Install as per manufacturers instructions and/or Detail on the Mechanical Drawings.

3.4 Supply, Return & Exhaust Fans

- .1 All connections to fans to be made utilizing canvas connections as specified under this Section.
- .2 All fan systems are to be equipped with all accessories indicated in schedule.
- .3 Refer to Section 15900 Controls and Instrumentation and Division 16 Wiring for Mechanical Equipment, and co-ordinate Work.

3.5 Acoustic Duct Liner

- .1 Install acoustic duct liner in all ducts shown diagonally-hatched, or otherwise specified with duct liner.
- .2 Apply adhesive to the interior of the duct and supplement the adhesive with welding pins and clips, the pins shall be spaced no further than 12" apart, no more than 4" in from a corner or edge of the duct. Duct 8" wide and smaller does not require adhesive supplement.
- .3 Trim all pieces of liner such that all corners and joints fit tight, without bulges.
- .4 Apply liner adhesive to all joints, seams, and exposed edges, including all traverse joints as the duct is assembled.
- .5 At the upstream leading edge of exposed liner, Provide a step collar or insulation stop to cover the entire edge of the exposed liner.
- .6 Interrupt the duct liner installation at fire dampers.
- .7 Where dampers (motorized or manual), turning vane, or other interior duct device is to be mounted, Provide a metal hat section or other build out to secure the damper or device. Fire dampers may not be mounted to a hat section, oversize fire dampers to the outside duct dimensions or Provide step collars on either side of the fire damper.

3.6 Combination Smoke & Fire Dampers

- .1 Install dampers in accordance with manufacturer's UL Installation Instructions. Any damper installation aspect that is not in accordance with the manufacturer's UL Installation Instructions must be approved prior to installation.
- .2 Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors in ductwork or plenums required to provide this access. The general contractor shall furnish any access doors required in walls, ceilings, or other general building construction.

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- .3 Install dampers square and free from racking.
 - .4 The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.
 - .5 Do not compress or stretch the damper frame into the duct or opening.
 - .6 Attach multiple damper section assemblies together in accordance with manufacturer's instructions.
 - .7 Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.
 - .8 Install connections to actuators.
 - .9 Attach multiple damper section assemblies together in accordance with manufacturer's instructions. Install support mullions as reinforcement between assemblies as required

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Air Distribution - Grilles & Diffusers

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.
- .2 Conform to Air Distribution - General Provisions, Section 15800.

1.2 Quality Assurance

- .1 Conform the latest edition, including Amendments of the following Codes and Standards.
- .2 Local and district by-laws, regulations and published engineering standards.
- .3 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 332/12 including all amendments.
- .4 SMACNA Standards.
- .5 ASHRAE Recommendations.
- .6 ASHRAE 90.1.

1.3 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 for the following equipment:
 - .1 Grilles
 - .2 Diffusers

PART 2 - PRODUCTS

2.1 Grilles & Diffusers

- .1 Supply and install grilles and diffusers of the type and size shown in the Schedule.
- .2 All grilles and diffusers are designated on the Drawings according to type and CFM. The Manufacturer shall check the Architectural Drawings and Provide the proper frame to suit ceiling or wall construction.
- .3 The Manufacturer shall provide a room schedule showing diffuser type, frame, CFM, and outlet velocity with his approval Drawings.
- .4 **Grilles:** Grilles shall have mounting frame and volume dampers. Dampers shall be key operated through the face. The finish shall be prime coat white enamel.
- .5 **Diffusers:** Diffusers shall have an equalizing grid and opposed blade damper in the supply collar. Finish shall be prime coat white enamel. Trim shall be panel type, overlapping, or interlocking type, as designated and to suit the construction.
- .6 Acceptable Products:
 - .1 Krueger
 - .2 Titus
 - .3 Airvector Inc.
 - .4 Nailor
 - .5 E. H. Price

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- .6 Metal Aire
- .7 Carnes

PART 3 - EXECUTION

3.1 Grilles & Diffusers

- .1 **Location:** Note that the grilles and diffusers are to be carefully centred in the tile or block work. The duct runouts and collars are to be carefully located and adjusted after the ceiling grid is installed. Abrupt offsets in the ductwork will not be accepted.
- .2 Review carefully with Sprinkler Contractor, the Architect's reflected ceiling plans and co-ordinate diffuser, sprinkler heads and light fixtures. Advise Consultant of any interferences.
- .3 Visible portions behind grilles shall be painted flat black by this Section.

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Air Distribution - Air Filters

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.
- .2 Conform to Air Distribution - General Provisions, Section 15800.

1.2 Quality Assurance

- .1 Conform the latest edition, including Amendments of the following Codes and Standards.
- .2 Local and district by-laws, regulations and published engineering standards.
- .3 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 332/12 including all amendments.
- .4 SMACNA Standards.
- .5 ASHRAE Recommendations.
- .6 ASHRAE 90.1.

1.3 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 - Submittals for the following equipment:
 - .1 Filters
 - .2 Filter Gauge

PART 2 - PRODUCTS

2.1 Filters

- .1 Filter average efficiency shall be 20% for 2" (50 mm) and 50% for 21-1/2" (535 mm) to ASHRAE standard 52-68.
- .2 Supply and install across each filter bank, a Dwyer Mark II Series, Model 40 air filter gauge.
- .3 Supply two (2) sets of filters for the following equipment:
 - .1 ERV-1
 - .2 Cabinet Heaters
- .4 Acceptable Products:
 - .1 National Air Filter
 - .2 American Air Filter
 - .3 Camfil (Farr)
 - .4 Cambridge Filter Corporation

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Air Distribution - Commercial Fans

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.
- .2 Conform to Air Distribution - General Provisions, Section 15800.

1.2 Quality Assurance

- .1 Conform to the latest edition, including Amendments of the following Codes and Standards.
- .2 Local and district by-laws, regulations and published engineering standards.
- .3 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 332/12 including all amendments.
- .4 SMACNA Standards.
- .5 ASHRAE Recommendations.
- .6 ASHRAE 90.1.

1.3 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 for the following equipment:
 - .1 Cabinet Blower Fans

PART 2 - PRODUCTS

2.1 General

- .1 Supply and install the following exhaust and recirculating fans of the size, type, model and designation as specified below and contained in the Fan Schedule. Accessories listed in the Specifications apply to all fans of the same designation. Special accessories for individual fans are designated on the Fan Schedule.
- .2 Sound level performance and fan curves shall be included with submittal Drawings.
- .3 Suspend fans from structure through vibration isolators and connect to ductwork through flexible duct connections. Mount fan in place with backdraft dampers and gasket seals. Provide seismic bracing as required.
- .4 Power wiring for fans is by Division 16.
- .5 Control wiring is by Section 15900.

2.2 Exhaust Fan - EF-1

- .1 Casing shall be enamelled steel with interior acoustic insulation, access panels on side and inlet and outlet duct connections.
- .2 Blower wheel shall be forward curve statically and dynamically balanced with ball bearings.
- .3 Motor shall be 1750 RPM, 'V' belt drive with variable pitch sheave on motor. Motor shall be rubber mounted for quiet operation.

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- .4 Accessories shall include:
 - .1 Backdraft Damper
- .5 Design is based on Cook
- .6 Acceptable Products:
 - .1 Penn Ventilator
 - .2 Greenheck
 - .3 Cook

PART 3 - EXECUTION

3.1 Exhaust Fan

- .1 General Division shall install curbs and flashings.
- .2 Mount and secure onto prefabricated curb.
- .3 Starter and power wiring by Division 16.
- .4 Control wiring by Section 15900.

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.
- .2 Conform to Air Distribution - General Provisions, Section 15800.

1.2 General

- .1 Supply and install the following Energy Recovery Ventilators of the size, type, model and designation, as specified below and contained in the Schedule on the Drawings.

1.3 Quality Assurance

- .1 Conform the latest edition, including Amendments of the following Codes and Standards.
- .2 Local and district by-laws, regulations and published engineering standards.
- .3 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 332/12 including all amendments.
- .4 Unit shall be designed in accordance with UL Standards.
- .5 Unit shall be ETL tested and certified.
- .6 Unit casing shall be capable of withstanding Federal Method Standard No. 141 (Method 6061) 500-hour salt spray.
- .7 The unit shall be ARI 1060 certified.
- .8 Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
- .9 Manufacturer Qualifications:
 - .1 Manufacturer regularly engaged in the manufacture of air handling units of similar type to that specified.
 - .2 ISO 9001 Certified company.
- .10 Installers Qualifications:
 - .1 Installation that regularly engaged in the installation of air handling units of similar type to that specified.
 - .2 Employ personnel trained for installation of air handling units.

1.4 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 - Submittals for the following equipment:
 - .1 Energy Recovery Ventilator

1.5 Delivery, Storage & Handling

- .1 **Delivery Requirements:** Deliver material to site in manufacturers original, unopened containers and packaging, with labels clearly identifying Product name and manufacturer.

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- .2 Storage and handling requirements:
 - .1 Store and handle materials in accordance with manufactures instructions.
 - .2 Keep materials in manufacturers original, unopened containers and packaging until installation.
 - .3 Store materials in a clean, dry area indoors.
 - .4 Protect materials during storage, handling and installation to prevent damage.

PART 2 - PRODUCTS

2.1 Energy Recovery Ventilators - DESIGNATED ERV

- .1 **General**
 - .1 Air Handling Units shall be built to the level of quality as herein specified and to the description of the Air Handling Unit Schedule.
 - .2 The substitution of any product other than that specified must ensure no deviation below the stated capacities, air flow rate, heat transfer rate, filtration efficiency and air mixing quality. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Applications for "equal" or "alternate" must address these factors.
 - .3 Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close approximation to the intent of this specification will not be considered equal. All equipment shall where specified and applicable, be pre-wired and factory certified by an approved testing agency such as ETL, UL, or CSA for the destination.
 - .4 All electrical circuits shall undergo a dielectric strength test and shall be factory tested and checked as to proper function.
 - .5 The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifty (50) continuous years of proven production experience.
 - .6 Air Handling Units shall be as manufactured by Engineered Air and be base bid. Cost savings must be shown for alternate products, and it must be clearly indicated in all areas where the alternate products do not meet the specified product.
 - .7 Packaged air-handling units are to be manufactured in Canada.
- .2 **Unit Construction**
 - .1 Unit casing shall be of minimum 18 ga (1.3 mm) satin coat galvanized sheet metal. Surfaces on indoor and outdoor units shall be cleaned with a degreasing solvent to remove oil and metal oxides. Outdoor units shall be primed with a two-part acid based etching primer. All unprotected metal and welds shall be factory coated.
 - .2 All exposed surfaces shall have a finish coat of DTM polyurethane (single coat) to all exposed surfaces with an ASTM B117 11 salt spray rating of 1,500 hrs.
 - .3 All walls, roofs, and floors shall be of formed construction with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.

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- .4 All internally insulated sections of the unit shall be provided with a 22 ga (.85 mm) solid, satin coat galvanized metal liner.
 - .5 Units shall be provided with access doors to the following components: fans, motors, filters, dampers and operators, access plenums, electrical control panels and burner/compressor compartments. Access doors shall be as large as practical for easy access. Screwed wall panel access will not be acceptable for the above listed components.
 - .6 Units shall be provided with hinged access doors with e-profile gasket, fully lined, and a minimum of two lever handles. Positive pressure sections with access doors must have a clear warning label and safety device must be affixed.
 - .7 All units shall be internally insulated with 1" (51 mm) thick, 1 1/2 lb./ ft.³ (24 kg/m³) density coated insulation.
 - .8 The coated insulation shall be secured to metal panels with a fire retardant adhesive and welded steel pins at 18" (450 mm) o/c. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent deterioration of exposed edges. Drain pans and all floor areas shall be insulated on the underside.
 - .9 Cooling coil drain pans shall be fabricated of 304 stainless steel and are an integral part of the floor paneling, a minimum of 2" (51 mm) deep with welded corners. Drain pans shall extend a minimum of 6" (152 mm) downstream of coil face and be provided with a 1-1/2" (38 mm) S.S. M.P.T. drain connection. All cooling coil drain pans shall have a fast pan and be sloped and pitched such that there is no standing water. Intermediate drain pans shall be provided where required for effective moisture removal.
 - .10 Outdoor units shall be weatherproofed and equipped for installation outdoors. Units shall be fabricated to prevent the infiltration of rain and snow: louvers or hoods shall be provided on air intakes and exhaust openings. Rain gutters or diverters shall be installed over all access doors. All joints shall be caulked with a water resistant sealant. The roof joints shall be turned up 2" (51 mm) with three break interlocking design and the outer wall panels shall extend a minimum of 1/4" (6 mm) below the floor panel. Unit floors shall incorporate welded floor to base construction. Floors are of three break upstanding design with welded corners and free of penetrations. Unit underside joints shall be caulked.
 - .11 Provide an 16" high seismic full perimeter roof mounting curb of heavy gauge sheet metal complete with wood nailer, neoprene sealing strip, and fully welded "Z" bar with 1" (25 mm) upturn on inner perimeter to provide a complete seal against the elements. External insulation and flashing of the roof-mounting curb shall be provided by the roofing subcontractor.
- .3 **Fans**
- .1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.
 - .1 Supply fans shall be backward inclined fans with airfoil or flat blade design shall be equipped with greaseable self-aligning ball or roller type pillow block bearings.

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- .2 Return fans shall be belt driven plenum type configuration where noted in schedules. Thrust restraint isolators shall be provided parallel to the shaft centerline when required to minimize axial movement and bending movements of the blower assembly(s). Drive side bearings on plenum fans shall be adapter style to ensure even clamping of the bearing sleeve to the shaft.
- .3 Provide open wire mesh protective screen on plenum fan inlet/outlet.
- .4 Toilet exhaust fans shall be single low pressure forward curved fans equipped with greaseable pillow block bearings supported on a rigid structural steel frame.
- .2 Fan motor sheaves shall be adjustable with motors 7 1/2 HP (5.6 kW) and smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure.
- .3 Provide full section return air fan(s) as scheduled. The use of power exhaust propeller type arrangements will not be considered.
- .4 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor that is welded to the structural frame of the unit. Use of separate bumpers or snubbers are not acceptable. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric with a sealed double locking fabric to metal connection.
- .5 All forward curve fans 18" (457 mm) in diameter and larger and all backward inclined fans shall incorporate vertical spring isolators with leveling bolts and bridge bearing waffled pads with minimum 1" (25 mm) static deflection designed to achieve high isolation efficiency.
- .6 Backward inclined fans with airfoil or flat blade design shall incorporate vertical spring isolators with leveling bolts and bridge bearing waffled pads with minimum 1" (25 mm) static deflection designed to achieve high isolation efficiency.
- .7 Plenum fans shall incorporate vertical spring isolators with leveling bolts and bridge bearing waffled pads with minimum 1" (25 mm) static deflection designed to achieve high isolation efficiency. Thrust restraints shall be provided to minimize axial movement of the fan assembly.
- .8 Fan motors shall be ODP (open drip proof) high efficiency type.
- .9 Provide variable air volume fan control for units as scheduled via a variable frequency drive which shall be mounted in the unit controls cabinet.
 - .1 Sine wave carrier input, PWM output. IGBT transistors. Adjustable acceleration and deceleration timing.
 - .2 Keypad to be removable, with alphanumeric display able to provide output status monitoring, output frequency, output voltage, output RPM, and output current. Include fault log display with capacity for the recent 30 faults with a time stamp. Diagnostic display menus to include reference speed command, heat sink temp, bus voltage, active I/O command status, time from power up, and current setting.
 - .3 Unit mounted manual VFD bypass switch locks out VFD, fan runs on maximum set volume. Bypass switch and all interlock contacts are factory mounted, pre-wired and external to the drive to allow for removal and repair if necessary.
 - .4 Line and load reactors required for all 460 and 575 volt applications.

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- .5 Drives shall be factory installed in a separate ventilated cabinet mounted on the unit with a hinged access door.
- .6 Minimum supply and return airflow of 50%.
- .10 Fan and motor sheaves shall be factory installed, fan balanced, and tested prior to shipment.
- .4 **Coils**
 - .1 Coils shall have 1/2" O.D. diameter tubes as manufactured by Engineered Air and constructed of copper tube, aluminum fin, and copper headers with schedule 40 steel pipe connectors.
 - .2 Fins constructed of aluminum or copper shall be corrugated for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a galvanized steel casing. All hydronic and DX refrigerant coils shall be factory tested with air at 300 psig (2068 kPa) while immersed in an illuminated water tank. All condenser refrigerant coils shall be factory tested with air at 650 psig (4482 kPa) while immersed in an illuminated water tank.
 - .3 Headers shall be outside the air-handling unit for maximum serviceability except for blow through applications where headers are internal. The non-headered end of the coil shall be fully concealed. Provide auxiliary drain pan complete with 1/2" (13 mm) SS MPT drain connection at headered end of cooling coils.
 - .4 Provide an insulated header cover to conceal exposed headers.
 - .5 Coils shall be removable from the unit at the header end unless shown otherwise on the drawings.
 - .6 DX refrigerant coils shall be circuited to provide adequate tube velocities to meet design requirements. Internal turbulators are not acceptable.
 - .7 Multiple row coils shall be of staggered tube design circuited to optimize capacity with minimum pressure drop.
 - .8 Refrigerant evaporator type coils shall be equipped with distributors connected to the coil by copper tubes. Solenoid valves, expansion valves, and related accessories shall be provided and installed by the refrigeration contractor.
 - .9 Refrigerant coils with multiple compressors shall be alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions.
- .5 **Gas Heat Section (DJS) - Indirect Fired**
 - .1 **General**
 - .1 Heating units shall be indirect natural gas fired approved for both sea level and high altitude elevations. The entire package including damper controls, fan controls, and all other miscellaneous controls and accessories shall be pre-wired and factory certified by an approved testing agency such as ETL, UL, or CSA for the destination.
 - .2 Operating natural gas pressure at unit(s) shall be 7" WC (1750 Pa).
 - .3 Gas fired units shall be approved for operation in -20°F (-29°C) locations.
 - .4 Installation and venting provisions must be in accordance with installation code CAN/CSA B149.1, ANSI Z223.1-NFPA54 and the requirements of the local authorities having jurisdiction.

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- .2 Heat Exchanger/Burner Assembly
 - .1 Heat exchanger shall be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane metal turbulators and shall be of a floating stress relief design. Heat exchanger shall be provided with condensate drain connection. The heat exchanger casing shall have 1" (25 mm) of insulation between the outer cabinet and inner heat reflective satin coat galvanized steel liner. Blower location shall be engineered to optimize the required air flow pattern around the heat exchanger. Duct type furnaces with closed coupled blowers are not acceptable.
 - .2 Units with high efficiency heat exchangers shall be tested and certified to the National Energy Code of Canada and local authorities having jurisdiction. A minimum of 81% efficiency shall be provided at maximum heating demand (high-fire) with increased efficiency at mid/low demand.
 - .3 The heat exchanger/burner assembly shall be a blow through positive pressure type. Units incorporating discharge air control shall have an interrupted pilot ignition system to provide increased safety. Units using continuous or intermittent pilots are not acceptable.
 - .4 Flame surveillance shall be from the main flame after ignition not the pilot flame. The burner and gas train shall be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.
- .3 Factory testing of indirect fired gas heating section.
 - .1 The minimum test requirements on all cabinet / fan size / fan type / fan orientation / heat exchanger / outlet configuration combinations previously built are listed below:
 - .1 Tests shall be performed after complete final unit assembly just prior to shipping to job site. The tests shall be performed in accordance with the equipment standard that the gas heating section is certified.
 - .2 Heat exchanger shall be clocked with a dedicated calibrated gas meter to ensure proper set up of the gas manifold.
 - .3 High and low input flue gas combustion analysis using a calibrated combustion analyzer including O₂ and CO to provide proper air fuel ratio throughout the entire operating range.
 - .4 High limit operational check shall be performed to ensure proper function at all normal airflows including loaded filters.
 - .5 If the unit is capable of or intended to operate at varying air flows, all of the above tests must be performed at high flow and low flow.
- .4 Venting
 - .1 Installation and venting provisions must be in accordance with installation code CAN/CSA B149.1, ANSI Z223.1-NFPA54 and the requirements of the local authorities having jurisdiction. Type A or L venting is required on DJE and DJS indoor units.
 - .2 Outdoor DJX unit provided with wedge style vent.
 - .1 Outdoor venting when installed close to a parapet or wall:
 - .2 A vertical style flue shall be provided that terminates approximately 6" (150 mm) above the unit's roof.

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- .5 The heat exchanger/burner assembly shall include 15:1 turndown for all input ranges. The high turn down heat exchanger/burner assembly minimum input shall be capable of controlling down to 6.7% of its rated input, excluding the pilot assembly, without on/off cycling and include built in electronic linearization of fuel and combustion air. Efficiency shall increase from high to low fire.
- .6 The CenCon c/w J-XM module (modulating fuel and combustion air) shall be complete with proportional and integral control and discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in the discharge air temperature.
 - .1 The controller shall be certified by ETL
 - .2 The combustion air motor speed shall vary proportionally in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions. The combustion blower RPM shall be proved using a Hall Effect speed sensor. Efficiency of the heat exchanger shall increase as the firing rate decreases.
 - .3 The controller shall provide a pre-purge and post purge cycle to provide a minimum of four air changes for each purge cycle through the heat exchanger.
 - .4 The controller shall provide a low fire start with controlled burner startup and shutdown.
 - .5 To ensure longevity of the equipment, the controller shall provide heat exchanger cooldown timing.
 - .6 Heating control function shall be modulating discharge air complete with sensor and integral selector.
- .7 Discharge air sensor shall be field mounted in supply ductwork by installing contractor.
- .6 **Filters**
 - .1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side of the unit as noted on the drawings.
 - .2 The filters shall be designed to slide out of the unit. Side removal filters shall slide into a formed metal track sealing against metal spacers at each end of the track.
 - .3 2" (50 mm) Extended media (Pleated) disposable filters shall be provided in the supply, return sections before the energy recovery wheel. Filters shall be extended surface pleated complete with 100% synthetic media that does not support microbial growth. Frame shall be a high wet strength beverage board with a cross member design that increases filter rigidity and prevent breaching. Frame shall be recyclable. Filters shall have an expanded metal support grid bonded to the air-exiting side of the filter to maintain pleat uniformity and prevent fluttering. Metal support grid shall be recyclable. The filters shall be MERV 8. A permanent re-usable metal enclosing frame shall be provided for side loaded applications.

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- .4 4" (100 mm) Extended media (Pleated) disposable filters shall be provided in the supply air tunnel after the energy recovery wheel and in the toilet exhaust airstream. Filters shall be mini pleat air filters complete with 100% synthetic media that does not support microbial growth. Frame shall be constructed with high impact plastic and impervious to moisture and high humidity. Media pack shall be adhered to plastic frame on all sides to prevent air by pass. Filters shall have a hot melt bead separator to maintain pleat pack stability and ensure consistent pleat spacing for optimum air flow. The filters shall be MERV 13 per ASHRAE 52.2 and rated U.L. 900 Class II. A permanent re-usable metal enclosing frame shall be provided for side loaded applications.
 - .1 The filter shall be labeled as to tested efficiency, rated/tested airflow, pressure drop, and shall be serialized for identification.
 - .2 Holding frames shall be constructed of a minimum of 14 ga (2 mm) galvanized steel. Frames shall be welded and include centering dimples, pre-drilled mounting holes, filter sealing flange, and swing bolt assemblies. An appropriate number of swing bolts to match air filters shall be included.
- .5 Where filters are provided in air handling units for make-up air applications and where hoar frost may occur, only steel frame filters are acceptable. Where indicated, units shall have both summer (upstream of heating coil or gas heat exchanger) and winter (downstream of heating coil or gas heat exchanger) filter sections. Only one set of filters shall be installed in either the summer or winter filter section dependent upon ambient conditions.
- .6 Provide two (2) sets of filters for the unit.
- .7 **Dampers**
 - .1 Outdoor air damper shall be aluminum low leak airfoil Tamco Series 9000. All other dampers shall be aluminum low leak airfoil Tamco Series 1000.
 - .2 Recirculation and balancing dampers shall be parallel blade type.
 - .3 Mix box controls shall be complete with:
 - .1 A packaged economizer with control that follows ASHRAE 90.1 compliance
- .8 **Mechanical Cooling**
 - .1 Compressors shall be hermetic scroll type set on resilient neoprene mounts. The compressors shall incorporate an internal or external pressure-limiting device to protect the compressor in the event of overpressure. Compressors shall be provided with a means of overload protection. External crankcase heaters shall be locked out during compressor operation.
 - .2 Air Cooled Condenser:
 - .1 Condenser coils shall be copper tube type, mechanically expanded into aluminum fins. Coils shall be factory pressure tested with air while immersed in an illuminated water tank.
 - .2 Condenser fans shall be direct drive propeller type arranged for vertical draw through airflow. Motors shall be weather resistant type with integral overload protection and designed for vertical shaft condenser fan applications. Fan and motor assemblies shall be mounted in a venturi for optimum efficiency with minimum noise level.
 - .3 Condenser fans shall be fully housed fan with protective screen and fluted blades for optimum efficiency with minimum noise level.

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- .4 Condenser section to form an integral part of the unit.
- .3 Packaged Air Conditioning Units:
 - .1 The entire package including fan controls, head pressure control, and all other miscellaneous controls and accessories shall be pre-wired and factory certified by an approved testing agency such as ETL, UL, or CSA for the destination.
 - .2 Unit must conform to regulations set out in the Canadian Energy Efficiency Act for large air conditioners. Packaged units shall be tested to CSA Standard C746-17 and must bear an EEV (energy efficiency verification) label provided by CSA.
 - .3 Unit must conform to regulations set out by the Department of Energy for large air conditioners. Packaged units shall be tested to AHRI 340/360-2007 and must bear an EEV (energy efficiency verification) label provided by CSA.
 - .4 Equipment shall operate down to 50°F (10°C) ambient temperature for mixed air and 58°F (14.4°C) ambient temperature for make-up-air applications. Where applicable, multiple refrigeration circuits shall be separate from each other. Refrigeration circuits shall be complete with TX valves, sight glass, liquid line filter-driers, and service ports fitted with Schrader fittings. Equipment shall have condensers designed for 15°F (8°C) liquid sub-cooling. The complete piping system shall be purged and pressure tested with dry nitrogen, then tested again under vacuum. Each system shall be factory run and adjusted prior to shipment.
 - .5 Packaged units shall be supplied with R-454B refrigerant.
 - .6 Controls for hermetic compressor units shall include compressor and condenser fan motor contactors, supply fan contactors and overload protection, control circuit transformer, cooling relays, ambient compressor lockout, anti short cycle and inter stage timers, and automatic reset low pressure controls. Compressors over 6 tons (21 kW) shall be complete with manual reset high pressure controls. Head pressure actuated fan cycling control shall be provided on all multiple condenser fan units.
 - .7 Provide hot gas bypass on the lead compressor to provide freeze protection in the event of low loads.
 - .8 Compressors shall be located on the side of the unit in a service enclosure complete with hinged access doors c/w lever handles for ease of service.
 - .9 Compressor enclosure shall include 1" (25 mm), 1-1/2 lb./ft³ acoustical coated insulation.
 - .10 Units shall have a minimum of 3 compressors
- .4 Cooling Control: The CenCon c/w C-XM module shall be complete with proportional and integral control with a discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature.
 - .1 The controller shall provide 3 stages of mechanical cooling.
 - .2 The controller shall have built-in minimum run time and anti-cycle timers.

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- .3 Mechanical cooling shall be disabled below a fixed low ambient temperature setpoint.
- .4 Cooling enable/disable shall be through controller demand.
- .5 When controller is in economizer mode, the mechanical cooling shall be disabled.

.9 Factory Supplied Controls/Wiring

- .1 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors, and terminals for the connection of external control devices or relays.
- .2 Gas fired units shall also include high limit and combustion airflow safeties.
- .3 Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.
- .4 Factory installed and wired non-fused disconnect switch in NEMA type 3R weatherproof configuration.
- .5 Controls shall be housed in a control panel mounted in or on the unit that will meet the standard of the specific installation.
- .6 CenCon:
 - .1 The controller shall be ETL and BTL certified.
 - .2 A graphic OLED display module shall provide temperatures and status of the equipment.
 - .3 The controller shall have a 9-button keypad for navigation of screens.
 - .4 The controller shall have a computer connection diagnostics via Ethernet complete with web based interface.
 - .5 The controller shall have 4 distinct modes (heating, economizer, ventilation and cooling). Each mode change is determined by the demand of the system.
 - .6 Minimum operating ambient temperature shall be -40°F (-40°C).
 - .7 The controller shall provide continuous ambient temperature sensing.
 - .8 Self-check on start-up shall be provided to ensure air proving and all sensors are operating within design tolerances.
 - .9 Blower delay functionality shall be provided to ensure damper(s) are open before blower starts.
 - .10 The controller shall have non-recycling auto by-pass low limit with alarm contacts.
 - .11 Temperature control shall be discharge air c/w internal setpoint adjustment on keypad.
 - .12 Controller shall be BACnet compatible though either MSTP or IP protocol.
- .7 Provide BACnet interface module for the BAS interface.

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.10 HRW Total Energy Wheel

- .1 Total Energy Wheel Certification: Provide an ARI certified (sizes AEW10-1200 to AEW10-3500) Recovery Air total energy wheel as manufactured and supplied by Engineered Air. The performance of the total energy wheel shall be certified to the ARI Air-to-Air Energy Recovery Ventilation Equipment Certification Program in accordance with ARI Standard 1060-2001. The effectiveness shall be reflective of the component performance only without the benefit of packaged equipment. Wheel material will not exceed a flame spread rating of 0 and a smoke developed rating of 40 when tested in accordance with UL 723 (2018) ASTM E84.
- .2 Heat Transfer Media:
 - .1 The total energy wheel shall be constructed of sheet aluminium with alternate layers corrugated and with adjacent layers glued to each other for stability. Two ply lubricated polyester/cotton thread c/w a tensile strength of 4.35 lbs (1.98 kg) with a type "Z" twist direction shall be glued to the sheet aluminium for additional strength. The sheet aluminium shall be tension wound onto a central hub. All aluminium surfaces shall be coated with a "zeolite" 4Å molecular sieve coating to provide water vapour transfer from one air stream to the other.
 - .2 The wheel shall be cleanable by vacuuming without damage to the aluminium or desiccant. Alternate reclaim devices shall meet or exceed the performance noted in the schedules without exceeding the fan power requirements specified.
- .3 Wheel Structure: Wheels shall be held securely together with metal spokes extending radially from the hub to the peripheral banding. Wheels of 1800 mm diameter and smaller are provided in one piece construction. Wheels of 2100 mm and 2400 mm diameter shall be constructed with four removable pieces, and 2700 mm to 3500 mm wheels shall be constructed with eight removable pieces.
- .4 Wheel Support: The wheel shall be supported by two pillow block bearings which in turn are supported by a steel support. The bearings shall be located to maximize the free area of the rotor as much as possible. The bearings shall be replaceable without removing the wheel from the air handling unit.
- .5 Wheel Seals: Wheels shall be provided with non-contact adjustable labyrinth seals around the perimeter of the wheel and across the face at the division between the supply and exhaust sectors to eliminate drag, wear, and ensure longevity.
- .6 Purge System: The unit shall be provided with a purge system to allow a percentage of outdoor air through the exhaust air sector to reduce the exhaust air entering the supply air stream.
- .7 Wheel Drive System: The wheel shall be driven by a continuous V-belt around the outer perimeter of the wheel connected to an inverter driven, three phase, AC motor for variable speed applications. Access to the motor and the drive shall be from the face of the wheel.

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- .8 Temperature Control: The CenCon c/w ER-XM module shall be complete with proportional and integral control and discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in the discharge air temperature.
 - .1 The controller shall provide temperature and frost control operation c/w accurate supply air temperature control and summer/winter operation.
 - .2 Energy recovery control function shall be incorporated into the control of the system discharge air setpoint. The controller shall utilize the heat recovery device to its full ability prior to enabling additional heating or cooling devices.
 - .3 Controller shall provide frost prevention: When the exhaust air temperature drops below the frost threshold, the controller setpoint shall be overridden to maintain a specific setpoint in the exhaust airstream. This setpoint is calculated based on the dewpoint of the return air to ensure maximum heat recovery is maintained while not allowing frost to accumulate on the heat recovery device.

PART 3 - EXECUTION

3.1 Energy Recovery Ventilators

- .1 Section 15800 to install energy recovery ventilators in accordance with manufacturer's instructions at locations indicated on the Drawings.
- .2 Install energy recovery ventilators in accordance with NFPA 70.
- .3 Install energy recovery ventilators level, plumb, and secure.
- .4 Do not expose electronic components to temperatures below 32 degrees F (0 degrees C) or above 122 degrees F (50 degrees C).
- .5 Adjust energy recovery ventilators for proper operation in accordance with manufacturer's instructions.
- .6 Instruction and Training:
 - .1 Provide instruction and training of Owner's personnel as required for operation and maintenance of energy recovery ventilators.
 - .2 Provide hands-on demonstrations of operation of system components and complete system, including user-level program changes and functions.
 - .3 Provide instruction and training by factory-trained and certified representative of manufacturer.
- .7 Protect installed energy recovery ventilators from damage during construction.
- .8 Power wiring by Division 16. Control wiring by Section 15900.
- .9 Drain pan to be trapped and allowed to spill into floor drain; by Section 15400.
- .10 Unit start-up is to be by Manufacturer Service Representative. Submit start-up report to Consultant.
- .11 Ductwork supplied and installed by Section 15800.
- .12 Supply comprehensive wiring diagrams to Division 16. Wiring diagrams shall be specific to this Project and shall be submitted with approval Drawings.

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- .13 Coordinate unit start-up and commissioning with the Commissioning Agent.
- .14 Submit start-up report to Commissioning Agent and Consultant.

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PART 1 - GENERAL

1.1 Related Sections

- .1 The following sections constitute Related Work:
 - .1 Section 15010 - Mechanical General Provisions
 - .2 Section 15011 - Submittals
 - .3 Section 15013 - Systems Balancing
 - .4 Section 15050 - Basic Materials and Methods
 - .5 Section 15600 - Hydronic Heat Generation & Humidification
 - .6 Section 15950 - Refrigeration Equipment
 - .7 Section 15800 - Air Distribution
 - .8 Section 16010 - Electrical General Provisions
 - .9 Section 16050 - Basic Electrical Materials and Methods
 - .10 Division 16 - Fire Alarm System

1.2 Description

- .1 **General:** Extend the existing Accutemo to serve the mechanical systems serving the addition. The control system shall consist of a high-speed, peer-to-peer network of DDC controllers interfaced to the existing Operator Workstation.

1.3 Description

- .1 General:
 - .1 The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and an operator workstation.
 - .2 System software shall be based on a server/thin-client architecture, designed around the open standards of web technology. The control system server shall be accessed using a web browser over the control system network, the Owner's local network, and remotely over the Internet (through the Owner's LAN).
 - .3 The intent of the thin-client architecture is to provide operators complete access to the control system via a web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to edit programming.

1.4 Description

- .1 General:
 - .1 The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and an operator workstation.
 - .2 The control system server and/or operator workstation shall provide for overall system supervision and configuration, graphical interface, management report generation, and alarm annunciation.
 - .3 The system shall support web browser access to the building data. A remote user using a standard web browser shall be able to access the control system and change adjustable setpoints with the proper password.

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1.5 Approved Control System Primary Manufacturers

- .1 The following are acceptable control system Manufacturers and Product lines:
 - .1 Accutemp. Contact Alex Voll Ph: 519-501-2869.
- .2 Use operator workstation software, controller software, custom application programming language, building controllers, custom application controllers, and application specific controllers only from Manufacturer and Product lines listed.
- .3 Other Products specified herein (such as sensors, valves, dampers, and actuators) need not be manufactured by the above Manufacturers.

1.6 Quality Assurance

- .1 Installer and Manufacturer Qualifications:
 - .1 The Installer shall have an established working relationship with Control System Manufacturer of not less than three years.
 - .2 Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present the certification of completed training including hours of instruction and course outlines.

1.7 Codes & Standards

- .1 Work, materials, and equipment shall comply with the most restrictive of local, provincial, and federal authorities' codes and ordinances or these plans and Specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
 - .1 Ontario Electrical Safety Code (OESC)
 - .2 Conform to the 2012 Ontario Building Code (OBC) Compendium containing the Building Code Act, and Ontario Regulation 332/12 including all amendments.
 - .3 ANSI/ASHRAE Standard 135-2004, BACnet - A Data Communication Protocol for Building Automation and Control Networks

1.8 System Performance

- .1 **Performance Standards:** System shall conform to the following minimum standards over network connections:
 - .1 Graphic Display: A graphic with 20 dynamic points shall display with current data within 10 seconds.
 - .2 Graphic Refresh: A graphic with 20 dynamic points shall update with current data within 8 seconds.
 - .3 Object Command: Devices shall react to command of a binary object within 2 seconds. Devices shall begin reacting to command of an analog object within 2 seconds.
 - .4 Object Scan: Data used or displayed at a controller or workstation shall have been current within the previous 6 seconds.
 - .5 Alarm Response Time: An object that goes into alarm shall be annunciated at the workstation within 45 seconds.
 - .6 Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. Select execution times consistent with the mechanical process under control.

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- .7 Performance: Programmable controllers shall be able to completely execute DCC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
- .8 Multiple Alarm Annunciation: Each workstation on the network shall receive alarms within 5 seconds of other workstations.

1.9 Submittals

- .1 Product Submittal Requirements:
 - .1 Meet requirements of Section 15011 for Shop Drawings, Product Data, and Samples.
 - .2 Provide **one (1) digital copy** of Shop Drawings and for hardware, software, and equipment to be installed or furnished.
 - .3 Begin no Work until submittals have been approved for conformity with design intent.
 - .4 Provide Drawings as AutoCAD 2018(or newer) compatible files on optical disk (file format: .dwg, .dxf, .vsd, or comparable) with three 11" x 17" prints of each Drawing.
 - .5 When Manufacturer's cut sheets apply to a Product series rather than a specific Product, clearly indicate applicable data by highlighting or other means.
 - .6 Clearly reference covered Specification and Drawing on each submittal. General catalogues shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work.
- .2 Provide submittals on the following:
 - .1 Direct Digital Control System Hardware:
 - .1 Complete bill of materials indicating quantity, Manufacturer, model number, and relevant technical data of equipment to be used.
 - .2 Manufacturer's description and technical data such as performance curves, Product Specification sheets, and installation and maintenance instructions for items listed below for other relevant items not listed below:
 - .1 Direct digital controllers (controller panels)
 - .2 Transducers and transmitters
 - .3 Sensors (including accuracy data)
 - .4 Actuators
 - .5 Valves
 - .6 Relays and switches
 - .7 Control panels
 - .8 Power supplies
 - .9 Batteries
 - .10 Operator interface equipment
 - .11 Wiring
 - .3 Wiring Diagrams and layouts for each control panel. Show termination numbers.
 - .4 Floor plan schematic diagrams indicating field sensor and controller hardware locations.
 - .2 Central System Hardware and Software:
 - .1 Complete bill of material indicating quantity, Manufacturer, model number, and relevant technical data of equipment used.

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- .2 Manufacturer's description and technical data, such as Product Specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this Contract not listed below:
- .3 Central Processing Unit (CPU)
 - .1 Monitors
 - .2 Keyboards
 - .3 Power supply
 - .4 Battery backup
 - .5 Interface equipment between CPU and control panels
 - .6 Operating system software
 - .7 Operator interface software
 - .8 Colour graphics software
 - .9 Third-party software
- .4 Schematic Diagrams of control, communication, and power wiring for central system installation. Label cables and ports with computer Manufacturer's model numbers and functions. Show interface wiring to control system.
- .5 List of colour graphics to be provided. Provide conceptual layout of pictures and data for each graphic, showing or explaining which other graphics can be directly accessed.
- .3 Controlled Systems:
 - .1 Riser diagrams showing control network layout, communication protocol, and wire types.
 - .2 Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
 - .3 Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - .4 Instrumentation list for each controlled system. List each control system element in a table. Show element name, type of device, Manufacturer, model number, and Product data sheet number.
 - .5 Mounting, wiring, and routing plan-view Drawing in 1/4 in. scale. Take into account HVAC, electrical, and other system's design and evaluation requirements. Show locations of concrete pads and bases and special wall bracing for panels to accommodate this work.
 - .6 Complete description of control system operation including sequences of operation. Include and reference a schematic diagram of controlled system.
 - .7 Point list for each system controller including inputs and outputs (I/O), point numbers, controlled device associated with each I/O point, and location of I/O device. Indicate alarmed and trended points.
- .4 Description of process, report formats, and checklists to be used in Part 3: Control System Demonstration and Acceptance.
- .5 BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and interface.

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- .3 Schedules:
 - .1 Schedule of Work provided within one month of Contract award indicating:
 - .1 Intended sequence of Work items
 - .2 Start date of each Work item
 - .3 Duration of each Work item
 - .4 Planned delivery dates for ordered material and equipment and expected lead time
 - .5 Milestones indicating possible restraints on Work by other trades or situations
 - .2 Monthly written status reports indicating Work completed and revisions to expected delivery dates. Include updated Project schedule of work.
- .4 **Project Record Documents:** Submit **one (1) digital copy** of record documents upon completion of installation for approval prior to the final completion. Submittal shall consist of:
 - .1 Project Record Drawings. As-built versions of the submittal shop Drawings provided as AutoCAD 2004 (or newer) compatible files on optical media and as 11" x 17" prints.
 - .2 Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Part 3: Control System Demonstration and Acceptance.
 - .3 Operation and Maintenance (O&M) Manual. As-built versions of submittal Product data.
 - .1 Names, addresses, and 24-hour telephone numbers of installing Contractors and service representatives for equipment and control systems.
 - .2 Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - .3 Programming manual or set of manuals with description of programming language and of statements for algorithms and calculations of point database creation and modification, of program creation and modification, and of editor use.
 - .4 Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventative maintenance and calibration; how to debug hardware problems; and how to replace or repair hardware.
 - .5 Documentation of all programs created using custom programming language including setpoints, turning parameters, and object database.
 - .6 Graphic files, programs, and database on magnetic or optical media.
 - .7 List of recommended spare parts with part numbers and Suppliers.
 - .8 Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.

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- .9 Complete original-issue copies of furnished software including operating systems, custom programming language, operator workstation software, and graphics software.
 - .10 Licences, guarantees, and warranty documents for equipment and systems.
 - .11 Recommended preventative maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- .5 **Training Materials:** Provide course outline and manuals for each class at least six weeks before first class. Consultant will modify course outlines and manuals if necessary to meet Owner's needs. Consultant will review and approve course outlines and manuals at least three (3) weeks before first class.

1.10 Warranty

- .1 Warrant work, as follows:
- .1 Warrant labour and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of the Owner's warranty service request.
 - .2 Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified Work is split into multiple Contracts or a multi-phase Contract, each Contract or phase shall have a separate warranty start date and period.
 - .3 If Consultant determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, Consultant will certify in writing that control system operation has been tested and accepted in accordance with the terms of this Specification. Date of acceptance shall begin warranty period.
 - .4 Provide updates to operator workstation software, Project-specific software, graphic software, database software, and firmware that resolve Contractor identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
 - .5 Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labour and materials shall be warranted. Demonstrate operable condition of reused devices at time of Consultant's acceptance.

1.11 Ownership of Proprietary Material

- .1 Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
- .1 Graphics
 - .2 Record Drawings
 - .3 Database
 - .4 Application programming code
 - .5 Documentation

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1.12 Definitions

- .1 **BACnet Interoperability Building Blocks (BIBB):** A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device in a Specification.
- .2 **BACnet/BACnet Standard:** BACnet communication requirements as defined by the latest version of ANSI/ASHRAE Standard 135 and approved addenda.
- .3 **Control Systems Server:** A computer(s) that maintain(s) the systems configuration and programming database.
- .4 **Controller:** Intelligent stand-alone control device. Controller is a generic reference to building controllers, custom application specific controllers, and application specific controllers.
- .5 **Direct Digital Control (DDC):** Microprocessor-based control, including Analog/Digital conversion and program logic.
- .6 **Gateway:** Bi-directional protocol translator connecting control systems that use different communication protocols.
- .7 **Local Area Network (LAN):** Computer or control system communications network limited to local building or campus.
- .8 **Master-Slave/Token:** Data link protocol as defined in the BACnet standard.
- .9 **Point-to-Point:** Serial communication as defined in the BACnet standard.
- .10 **Primary Controlling LAN:** High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below.
- .11 **Protocol Implementation Conformance Statement:** A written document that identifies the particular options specified by BACnet that are implemented in a device.
- .12 **Router:** A device that connects two or more networks at the network layer.
- .13 **Wiring:** Raceways, fittings, wire, boxes and related items.

PART 2 - PRODUCTS

2.1 Materials

- .1 Use new Products that the Manufacturer is currently manufacturing and that have been installed in a minimum of 25 installations. Do not use this installation as a product test site unless explicitly approved in writing Owner or Owner's representative. Spare parts shall be available for at least **five (5) years** after completion of this Contract.

2.2 Communication

- .1 Control Products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to *ANSI/ASHRAE Standard 135-2004, BACnet*.
- .2 Each controller shall have a communication port for connection to an operator interface.
- .3 Project Drawings indicate remote buildings or sites to be connected by a nominal 56,000 baud modem over voice-grade telephone lines. In each remote location, a modem and field device connection shall allow communication with each controller on the internetwork as specified below.

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- .4 Internetwork operator interface and value passing shall be transparent to internetwork architecture.
- .5 An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, reports, system software, and custom programs shall be viewable and editable from each internetwork controller.
- .6 Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute specified control system operation. An authorized operator shall be able to edit cross-controller links by typing a standard object address.
- .7 System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring. Expansion shall not require operator interface hardware additions or software revisions.
- .8 Interface to existing BAS head end.

2.3 Operator Interface

- .1 **System Software:**
 - .1 Operating System. Update existing workstation operating software as required to support controls for the Addition. The operating system also shall support the use of other common software applications. Examples include Microsoft Excel, WordPerfect, and Microsoft Access. Acceptable operating systems are Windows 2000, Windows XP, Windows Server 2003, Linux and UNIX.
 - .2 System Graphics. The operator workstation software shall be graphically oriented. The system shall allow display of up to 10 graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on-line. An operator with the proper password level shall be able to add, delete, or change dynamic objects on a graphic. Dynamic objects shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the object.
 - .3 Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in industry standard formats such as PCX, TIFF, and GEM. The graphics generation package also shall provide the capability of capturing or converting graphics from other programs such as Designer or AutoCAD.
 - .4 Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. The library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

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- .2 **System Applications.** The existing workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation:
- .1 Automatic System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each Building Controller. This database shall be updated whenever a change is made in any system panel. The storage of these data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first workstation to detect the loss shall automatically restore the database for that panel. This capability may be disabled by the operator.
 - .2 Manual Database Save and Restore. A system operator with the proper password clearance shall be able to save the database from any system panel. The operator also shall be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
 - .3 System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection.
 - .4 On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
 - .5 Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the functions accessible to viewing and/or changing each system application, editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time period shall be user-adjustable. All system security data shall be stored in an encrypted format.
 - .6 System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
 - .7 Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, alarm limit differentials, states, and reactions for each object in the system.
 - .8 Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying upon acronyms or other mnemonics.
 - .9 Alarm Reactions. The operator shall be able to determine (by object) what, if any, actions are to be taken during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialling out to remote stations, paging, providing audible annunciation, or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day.

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- .10 Trend Logs. The operator shall be able to define a custom trend log for any data object in the system. This definition shall include interval, start time, and stop time. Trend data shall be sampled and stored on the building controller panel, be archivable on the hard disk, and be retrievable for use in spreadsheets and standard database programs.
- .11 Alarm and Event Log. The operator shall be able to view all system alarms and change of states from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk of the workstation.
- .12 Object and Status Property and Control. Provide a method for the operator to view, and edit if applicable, the status of any object and property in the system. The status shall be available by menu, on graphics, or through custom programs.
- .13 Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data, content, format, interval, and date. Report data shall be archivable on the hard disk for historical reporting. Provide the ability for the operator to obtain real-time logs of all by objects by type or status (e.g., alarm, lockout, normal). Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications, including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer and shall be set to be printed either on operator command or at a specific time each day.
- .14 Standard Reports. The following standard system reports shall be provided for this Project. Provide ability for the Owner to readily customize these reports for this Project.
 - .1 All Objects: All system (or subsystem) objects and their current values.
 - .2 Alarm Summary: All current alarms (except for those in alarm lockout.)
 - .3 Disabled Objects: All objects that are disabled.
 - .4 Alarm Lockout Objects: All objects in alarm lockout (whether manual or automatic).
 - .5 Alarm Lockout Objects in Alarm: All objects in alarm lockout that are not currently in alarm.
 - .6 Logs:
 - .1 Alarm History
 - .2 System Messages
 - .3 System Events
 - .4 Trends
- .15 Custom Reports. Provide the capability for the operator to easily define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title and the name of the facility.
- .16 Tennant Override Reports. Provide a monthly report showing the daily total time in hours that each tenant has requested after-hours HVAC and lighting services. Provide an annual summary report that shows the override usage on a monthly basis.

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- .17 Electrical, Gas, and Weather Reports:
 - .1 Electrical Meter Report: Provide a monthly report showing the daily electrical consumption and peak electrical demand with time and date stamp for each building meter.
 - .2 Provide an annual (12-month) summary report showing the monthly electrical consumption and peak demand with time and date stamp for each meter.
 - .3 Gas Meter Report: Report a monthly report showing the daily natural gas consumption for each meter. Provide an annual (12-month) report that shows the monthly consumption for each meter.
 - .4 Weather Data Report: Provide a monthly report showing the daily minimum, maximum, and average outdoor air temperature, as well as the number of heating and cooling degree-days for each day. Provide an annual (12-month) report showing the minimum, maximum, and average outdoor temperature for the month, as well as the number of heating and cooling degree-days for the month.

2.4 Controller Software

- .1 Furnish the following applications software for building and energy management. All software applications shall reside and operate in the system controllers. Editing of applications shall occur at the operator workstation.
- .2 System Security:
 - .1 User access shall be secured using individual security passwords and user names.
 - .2 Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.
 - .3 User Log On/ Log Off attempts shall be recorded.
 - .4 The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user-definable.
- .3 **Scheduling:** Provide the capability to schedule each object or group of objects in the system. Each schedule shall consist of the following:
 - .1 Weekly Schedule. Provide separate schedules for each day of the week. Each of these schedules should include the capability for start, stop, optimal start, optimal stop, and night economizer. Each schedule may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to adjust the start and stop times for each member.
 - .2 Exception schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by the standard schedule for that day of the week.
 - .3 Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.

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- .4 **System Coordination:** Provide a standard application for the proper coordination of equipment. This application shall provide the operator with a method of grouping together equipment based on function and location. The group may be used for scheduling and other applications.
- .5 **Binary Alarms:** Each Binary object shall be set to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.
- .6 **Analog Alarms:** Each analog object shall have both high and low alarm limits. Alarming must be able to be automatically and manually disabled.
- .7 **Alarm Reporting:** The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display graphics.
- .8 **Remote Communication:** The system shall have the ability to dial out in the event of an alarm using BACnet PTP. Receivers shall be BACnet workstations.
- .9 **Maintenance Management:** The system shall monitor equipment status and generate maintenance messages based upon user-designed run-time, starts, and/or calendar date limits.
- .10 **Sequencing:** Provide application software based upon the sequences of operation specified to properly sequence chillers, boilers, and pumps.
- .11 **PID Control:** A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-windup shall be supplied. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The controlled variable, set point, and PID gains shall be user-selectable.
- .12 **Staggered start:** The application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order, in which equipment (or groups of equipment) is started along with the time delay between starts, shall be user-selectable.
- .13 **Anti-short cycling:** All binary output objects shall be protected from short-cycling. This feature shall allow minimum on-time and off-time to be selected.
- .14 **On/off control with differential:** Provide an algorithm that allows a binary output to be cycled based on a controlled variable and set point. This algorithm shall be direct-acting or reverse-acting and incorporate an adjustable differential.
- .15 **Run-time totalization:** Provide software to totalise run-times for all binary input objects. A high run-time shall be assigned, if required, by the operator.

2.5 Building Controllers

- .1 **General:** Provide an adequate number of building controllers to achieve the performance specified in the Part 1 Article on System Performance. Each of these panels shall meet the following requirements:
 - .1 The Building Automation System shall be composed of one or more independent, stand alone, microprocessor-based building controllers to manage the global strategies described in the System Software Section.
 - .2 The building controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - .3 Data shall be shared between networked building controllers.

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- .4 The operating system of the building controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
 - .5 Controllers that perform scheduling shall have a real-time clock.
 - .6 The building controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - .1 Assume a predetermined failure mode,
 - .2 Generate an alarm notification.
 - .7 The Building Controller shall communicate with other BACnet devices on the internetwork using the Read (Initiate) and Write (Execute) Property Services as defined in clauses 15.5 and 15.8, respectively, of ASHRAE Standard 135-1995.
- .2 **Communication:**
- .1 Each building controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet Data Link/Physical layer protocol). Each building controller also shall perform BACnet routing if connected to a network of custom application specific controllers.
 - .2 The controller shall Provide a service communication port using BACnet Data Link/Physical layer protocol for connection to a portable operator's terminal.
- .3 **Environment:** Controller hardware shall be suitable for the anticipated ambient conditions.
- .1 Controllers used in outdoors and/or in wet ambient conditions shall be mounted within water-proof enclosures and shall be rated for operation at -40°C to 65°C (-40°F to 150°F).
 - .2 Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- .4 **Keypad:** A local keypad and display shall be Provided for each controller. The keypad shall be Provided for interrogating and editing data. An optional system security password shall be available to prevent unauthorized use of the keypad and display. If the Manufacturer does not provide this keypad and display, Provide a portable operator terminal.
- .5 **Serviceability:** Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
- .6 **Memory:** The building controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- .7 **Immunity to Power and Noise:** Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).

2.6 Custom Application Controllers

- .1 **General:** Provide an adequate number of custom application controllers to achieve the performance specified above. Each of these panels shall meet the following requirements:
 - .1 The custom application controller shall have sufficient memory to support its operating system, database, and programming requirements.

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- .2 Data shall be shared between networked custom application controllers.
 - .3 The operating system of the controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms.
 - .4 Controllers that perform scheduling shall have a real-time clock.
 - .5 The custom application controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - .1 Assume a predetermined failure mode,
 - .2 Generate an alarm notification.
 - .6 The custom application controller shall communicate with other BACnet devices on the internetwork using the Read (Initiate) and Write (Execute) Property Services as defined in Clauses 15.5 and 15.8, respectively, of ASHRAE Standard 135-1995.
- .2 **Communication:**
- .1 Each custom application controller shall reside on a BACnet network using the MS/TP Data Link/ Physical layer protocol.
 - .2 The controller shall Provide a service communication port using Data Link/ Physical layer protocol for connection to a portable operator's terminal.
- .3 **Environment:** Controller hardware shall be suitable for the anticipated ambient conditions.
- .1 Controllers used outdoors and/or in wet ambient conditions shall be mounted within water-proof enclosures and shall be rated for operation at -40°C to 65°C (-40°F to 150°F).
 - .2 Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- .4 **Keypad:** A local keypad and display shall be Provided. The keypad shall be Provided for interrogating and editing data. An optional system security password shall be available to prevent unauthorized use of the keypad and display.
- .5 **Serviceability:** Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
- .6 **Memory:** The custom application controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- .7 **Immunity to power and noise:** Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).

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2.7 Application Specific Controllers

- .1 **General:** Application specific controllers (ASCs) are microprocessor-based DDC controllers, which through software or firmware design are dedicated to control a specific piece of equipment. They are not fully user-programmable but are customized for operation within the confines of the equipment they are designed to serve. Application specific controllers shall communicate with other BACnet devices on the internetwork using the Read (Execute) Property Service as defined in Clause 15.5 of ASHRAE Standard 135-1995.
 - .1 Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 - .2 Each ASC will contain sufficient I/O capacity to control the target system.
- .2 **Communication:**
 - .1 The controller shall reside on a BACnet network using the MS/TP Data Link/Physical layer protocol. Each network of controllers shall be connected to one building controller.
 - .2 Each controller shall have a BACnet Data Link/Physical layer compatible connection for a laptop computer or a portable operator's tool. The connection shall be extended to a space temperature sensor port where shown.
- .3 **Environment:** The hardware shall be suitable for the anticipated ambient conditions.
 - .1 Controllers used outdoors and/or in wet ambient conditions shall be mounted within water-proof enclosures and shall be rated for operation at -40°C to 65°C (-40°F to 150°F).
 - .2 Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- .4 **Serviceability:** Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
- .5 **Memory:** The application specific controller shall use non-volatile memory and maintain all BIOS and programming information in the event of a power loss.
- .6 **Immunity to power and noise:** Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).
- .7 **Transformer:** Power supply for the ASC must be rated at a minimum of 125% ASC power consumption and shall be of the fused or current limiting type.

2.8 Input/Output Interface

- .1 Hardwired inputs and outputs may tie into the system through building, custom application, or application specific controllers.
- .2 All input and output points shall be protected such that shorting of the point to itself, to another point, or to the ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

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- .3 Binary inputs shall allow the monitoring of On/Off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense dry contact closure without external power (other than that provided by the controller) being applied.
- .4 Pulse accumulation input objects: This type of object shall conform to all the requirements of binary input objects and also accept up to 10 pulses per second for pulse accumulation.
- .5 Analog inputs shall allow the monitoring of low-voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to, commonly available sensing devices.
- .6 Binary outputs shall provide for On/Off operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers shall have three-position (On/Off/Auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.
- .7 Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs on building or custom application controllers shall have status lights and a two-position (AUTO/MANUAL) switch and manually adjustable potentiometer for manual override. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.
- .8 **Tri-State Outputs:** Provide tri-state outputs (two co-ordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone-dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
- .9 Input/Output points shall be the universal type, i.e., controller input or output may be designated (in software) as either a binary or analog type point with appropriate properties. Application specific controllers are exempted from this requirement.
- .10 **System Object Capacity:** The system size shall be expandable to at least twice the number of input/output objects required for this Project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interface installed for this Project shall not require any hardware additions or software revisions in order to expand the system.

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2.9 Power Supplies & Line Filtering

- .1 Control Transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service in accordance with OESC requirements. Limit connected loads to 80% of rated capacity.
- .1 DC Power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand a 150% current overload for at least three seconds without trip-out or failure.
 - .1 Unit shall operate between 0°C and 50°C (32°F to 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MIL-STD 810C for shock and vibration.
 - .2 Line voltage units shall be UL recognized and CSA approved.
- .2 Power Line Filtering:
 - .1 Provide transient voltage and surge suppression for all workstations and controllers either internally or as an external component. Surge protection shall have the following at a minimum:
 - .1 Dielectric strength of 1000 Volts minimum
 - .2 Response time of 10 nanoseconds or less
 - .3 Transverse mode noise attenuation of 65 dB or greater
 - .4 Common mode noise attenuation of 150 dB or better at 40 Hz to 100 Hz

2.10 Auxiliary Control Devices

- .1 Motorized control dampers, unless otherwise specified elsewhere, shall be as follows:
 - .1 Control dampers shall be the parallel or opposed blade type as below or as scheduled on Drawings.
 - .1 Outdoor and/or return air-mixing dampers and face and bypass (F&BP) dampers shall be parallel blade, arranged to direct air streams toward each other.
 - .2 Other modulating dampers shall be the opposed blade type.
 - .3 Two-position shutoff dampers may be parallel or opposed blade type with blade and side seals.
 - .2 Damper frames shall be 13 gauge galvanized steel channel or 1/8 in. extruded aluminum with reinforced corner bracing.
 - .3 Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades are to be suitable for medium velocity performance (10 m/s (2000 fpm)). Blades shall be not less than 16 gauge.
 - .4 Damper shaft bearings shall be as recommended by Manufacturer for application, oil impregnated sintered bronze or better.
 - .5 All blade edges and top and bottom of the frame shall be Provided with replaceable butyl rubber or neoprene seals. Side seals shall be spring-loaded stainless steel. The blade seals shall provide for a maximum leakage rate of 50 L/s per m² (10 CFM per ft²) at 1000 Pa (4 in. w.g.) differential pressure. Provide air foil blades suitable for a wide-open face velocity of 7.5 m/s (1500 fpm).

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- .6 Individual damper sessions shall not be larger than 125 cm x 50 cm (48 in. x 60 in.). Provide a minimum of one damper actuator per section.
- .7 Modulating dampers shall provide a linear flow characteristic where possible.
- .8 Dampers shall have exposed linkages.
- .2 **Electric damper/valve actuators:**
 - .1 The actuator shall have mechanical or electronic stall protection to prevent damage to the actuator through the rotation of the actuator.
 - .2 Where shown, for power-failure/safety applications, an internal mechanical, spring-return mechanism shall be built into the actuator housing. Alternatively, an uninterruptible power supply (UPS) may be Provided.
 - .3 Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range.
 - .4 All 24 VAC/VDC actuators shall operate on Class 2 wiring.
 - .5 All non-spring-return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring-return actuators with more than 7 Nm (60 in.lb.) torque capacity shall have a manual crank for this purpose.
- .3 **Control Valves:**
 - .1 Control valves shall be two-way or three-way type modulating service.
 - .2 Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - .1 Water Valves:
 - .1 Two-way: 150% of total system (pump) head.
 - .2 Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - .2 Water Valves:
 - .1 Body and trim style and materials shall be in accordance with Manufacturer's recommendations for design conditions and services shown, with equal percentage ports for modulating service.
 - .2 Sizing Criteria:
 - .1 Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi, whichever is greater.
 - .2 Three-way modulation service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa (5 psi) maximum.
 - .3 Valves 1/2 in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disk or stainless steel ball.
 - .4 Valves 2-1/2 inches and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
 - .3 Water valves shall fail normally open or closed, as scheduled on plans, or as follows:

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- .1 Water zone valves - normally open preferred.
- .2 Heating coils in air handlers - normally open.
- .3 Chilled water control valves - normally closed.
- .4 Other applications - as scheduled or as required by sequences of operation.

.4 Binary Temperature Devices:

- .1 Low-voltage space thermostat shall be 24V, bimetal-operated, mercury switch-type, with either adjustable or fixed anticipation heater, concealed set point adjustment, 13°C to 30°C (55°F to 85°F) set point range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
- .2 Line-voltage space thermostat shall be bimetal-actuated, open contact type, or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed set point adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
- .3 Low-limit thermostats. Low-limit airstream thermostats shall be UL listed, vapour pressure type, with an element of 6 m. (20 ft.) minimum length. Element shall respond to the lowest temperature sensed by any 30 cm (1 ft.) section. The low-limit thermostat shall be manual reset only.

.5 Temperature Sensors:

- .1 Temperature Sensor shall be Resistance Temperature Service (RTD) or thermistor.
- .2 Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft.) in length as per 1 m² (10 ft²) of duct cross section.
- .3 Immersion sensors shall be Provided with a separable well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.
- .4 Space sensors shall be equipped with local set point adjustment, override switch, and display.
- .5 Provide matched temperature sensors for differential temperature measurement.

.6 Flow switches:

- .1 Flow-proving switches shall be either paddle or differential pressure type, as shown.
- .2 Paddle-type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum) and shall have adjustable sensitivity with NEMA 1 enclosure unless otherwise specified.
- .3 Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as specified.

.7 Relays:

- .1 Control Relays shall be UL listed plug-in type with dust cover and LED energized indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

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- .2 Time delay relays shall be UL listed solid state plug-in type with adjustable time delay. Delay shall be adjustable $\pm 200\%$ (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.
- .8 **Override timers:** Override timers shall be spring-wound line voltage, UL listed, with contact rating and configuration as required by application. Provide 0-to-6-hour calibrated dial unless otherwise specified. Timer shall be suitable for flush mounting on control panel face and located on local control panels or where shown.
- .9 **Current transmitters:**
 - .1 AC current transmitters shall be the self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4 to 20 mA two-wire output. Unit ranges shall be a 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A full scale, with internal zero and span adjustment and $\pm 1\%$ full-scale accuracy at 500 ohm maximum burden.
 - .2 Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA Recognized.
 - .3 Unit shall be split-core type for clamp-on installation on existing wiring.
- .10 **Current transformers:**
 - .1 AC current transformers shall be UL/CSA recognized and completely encased (except for terminals) in approved plastic material.
 - .2 Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
 - .3 Transformers shall be fixed-core or split-core type for installation on new or existing wiring, respectively.
- .11 **Voltage transmitters:**
 - .1 AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4 to 20 mA output with zero and span adjustment.
 - .2 Ranges shall include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with $\pm 1\%$ full-scale accuracy with 500 ohm maximum burden.
 - .3 Transmitters shall be UL/CSA Recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1 requirements.
- .12 **Voltage transformers:**
 - .1 AC voltage transformers shall be UL/CSA recognized, 600 VAC rated, complete with built-in fuse protection.
 - .2 Transformers shall be suitable for ambient temperatures of 4°C to 55°C (40°F to 130°F) and shall provide $\pm 0.5\%$ accuracy at 24 VAC and a 5 VA load.
 - .3 Windings (except for terminals) shall be completely enclosed with metal or plastic material.
- .13 **Current switches:** Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

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.14 Pressure transducers:

- .1 Transducer shall have linear output signal. Zero and span shall be field adjustable.
- .2 Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
- .3 Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
- .4 Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and five valve manifold.

- .15 Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, as shown.

.16 Pressure-Electric (PE) Switches:

- .1 Shall be metal or neoprene diaphragm actuated, operating pressure rated 0-175 kPa (0-25 psig), with calibrated scale setpoint range of 14-125 kPa (2-18 psig) minimum, UL listed.
- .2 Provide one or two-stage switch action SPDT, DPST, or DPDT, as required by application. Electrically rated, for pilot duty service (125 VA minimum) and/or for motor control.
- .3 Shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
- .4 Shall have a permanent indicating gauge on each pneumatic signal line to PE switches.

.17 Local control panels:

- .1 All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.
- .2 Interconnections between internal and face mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/interlock Drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control Drawings.
- .3 Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

2.11 Wiring & Raceways

- .1 **General:** Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 16.
- .2 All insulated wire to be copper conductors, UL labelled for 90°C minimum service.

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PART 3 - EXECUTION

3.1 Examination

- .1 The Project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Consultant for resolution before rough-in Work is started.
- .2 The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Consultant for resolution before rough-in Work is started.
- .3 The Contractor shall examine the Drawings and Specifications for other parts of the work. If head room or space conditions appear inadequate -or if any discrepancies occur between the plans and the Contractor's Work and the plans and the Work of others -the Contractor shall report these discrepancies to the Consultant and shall obtain written instructions for any changes necessary to accommodate the Contractor's Work with the Work of others. Any changes in the Work covered by this Specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by, and at the expense of, this Contractor.

3.2 Protection

- .1 The Contractor shall protect all Work and material from damage by his/her Work or employees and shall be liable for all damage thus caused.
- .2 The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect any material that is not immediately installed. The Contractor shall close all open ends of Work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 Coordination

- .1 **Site:**
 - .1 Where the mechanical Work will be installed in close proximity to, or will interfere with, Work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If the Contractor installs his/her Work before coordinating with other trades, so as to cause any interference with Work of other trades, the Contractor shall make the necessary changes in his/her Work to correct the condition without extra charge.
 - .2 Coordinate and schedule Work with all other Work in the same area, or with Work that is dependant upon other work, to facilitate mutual progress.
- .2 **Submittals:** Refer to the Submittals article in Part 1 of this Specification for requirements.
- .3 **Test and Balance:**
 - .1 The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
 - .2 The Contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
 - .3 In addition, the Contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.

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- .4 The tools used during the test and balance process will be returned at the completion of the testing and balancing.
- .4 **Life Safety:**
 - .1 Duct smoke detectors required for air handler shutdown are supplied under Division 16 in the Specification. The Contractor shall interlock smoke detectors to air handlers for shut down as described in Part 3, Sequences of Operation.
 - .2 Smoke dampers and actuators required for duct smoke isolation are Provided under a section of Division 15. The Contractor shall interlock these dampers to the air handlers as described in Part 3 Sequences of Operation.
 - .3 Fire/smoke dampers and actuators required for fire rated walls are Provided under another section of Division 15. Control of these dampers shall be by Division 16.
- .5 Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this Specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the Contractor as follows:
 - .1 All communication media and equipment shall be Provided as specified in Part 2 Communication of this Specification.
 - .2 Each Supplier of a controls Product is responsible for the configuration, programming, start-up, and testing of that Product to meet the sequences of operation described in this section.
 - .3 The Contractor shall coordinate and resolve any incompatibility issues that arise between the control Products provided under this section and those provided under other sections or divisions of this Specification.
 - .4 The Contractor is responsible for providing all controls described in the Contract Documents regardless of where within the Contract Documents these controls are described.
 - .5 The Contractor is responsible for the interface of control Products provided by multiple Suppliers regardless of where this interface is described within the Contract Documents.

3.4 General Workmanship

- .1 Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- .2 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- .3 Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).
- .4 Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- .5 All equipment, installation, and wiring shall comply with acceptable industry Specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

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3.5 Field Quality Control

- .1 All work, materials, and equipment shall comply with the rules and regulations of applicable local, provincial, and federal codes and ordinances as identified in Part 1 of this Specification.
- .2 Contractor shall continually monitor the field installation for code compliance and quality of workmanship.
- .3 Contractor shall have Work inspected by local and/or provincial authorities having jurisdiction over the work.

3.6 Existing Equipment

- .1 **Wiring:** The integrity of the wire and its proper application to the installation are the responsibility of the Contractor. The wire shall be properly identified and tested in accordance with this specification.
- .2 **Temperature Sensor Wells:** The Contractor may reuse any existing wells in piping for temperature sensors. These wells shall be modified as required for proper fit of new sensors.
- .3 **Indicator Gauges:** Where these devices remain and are not removed, they must be made operational and recalibrated to ensure reasonable accuracy. Maintain the operation of existing pneumatic transmitters and gauges.
- .4 The Mechanical System must remain in operation between the hours of 6 a.m. and 6 p.m., Monday through Friday. No modifications to the system shall cause the mechanical system to be shut down for more than 15 minutes or to fail to maintain space comfort conditions during any such period. Perform cut-over of controls that cannot meet these conditions outside of those hours.
- .5 The scheduling of fans through existing or temporary time clocks or control system shall be maintained throughout the DDC system installation.
- .6 Install control panels where shown.
- .7 Patch holes and finish to match existing walls.

3.7 Wiring

- .1 All control and interlock wiring shall comply with national and local electrical codes and Division 16 of this specification. Where the requirements of this section differ from those in Division 16, the requirements of this section shall take precedence.
- .2 All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway according to OESC and Division 16 requirements.
- .3 All low-voltage wiring shall meet OESC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current limit.)
- .4 Where OESC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.
- .5 All wiring in mechanical, electrical, or service rooms -or where subject to mechanical damage -shall be installed in raceway at levels below 3 m (10 ft.).

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- .6 Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- .7 Do not install wiring in raceway containing tubing.
- .8 Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft.) intervals.
- .9 Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- .10 All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- .11 All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- .12 Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Contractor shall Provide step-down transformers.
- .13 All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- .14 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- .15 Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the Manufacturer's recommendations and OESC requirements, except as noted elsewhere.
- .16 Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- .17 Use coded conductors throughout with conductors of different colours.
- .18 Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- .19 Conceal all raceways, except within mechanical, electrical or service rooms. Install raceway to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes or flues).
- .20 Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung in flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- .21 Adhere to Division 16 requirements where raceway crosses building expansion joints.
- .22 Install insulated brushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
- .23 The Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- .24 Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 1 m (3 ft.) in length and shall be supported at each end. Flexible metal raceway less than 1/2 in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.

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- .25 Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.8 Communication Wiring

- .1 The Contractor shall adhere to the items listed in the Wiring Article in Part 3 of the specification.
- .2 All cabling shall be installed in a neat and workmanlike manner. Follow the Manufacturer's installation recommendations for all communication cabling.
- .3 Do not install communication wiring in raceway and enclosures containing Class 1 or Class 2 wiring.
- .4 Maximum pulling, tension, and bend radius for cable installation, as specified by the cable Manufacturer, shall not be exceeded during installation.
- .5 Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
- .6 When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the Manufacturer's instructions.
- .7 All runs of communication wiring shall be un-spliced length when that length is commercially available.
- .8 All communication wiring shall be labelled to indicate organization and destination data.
- .9 Grounding of coaxial cable shall be in accordance with NEC regulations article on Communications Circuits, Cable, and Protector Grounding.
- .10 All communication wiring shall be UL Listed in approved raceway according to OESC and Division 16 requirements.

3.9 Installation of Sensors

- .1 Install sensors in accordance with the Manufacturer's recommendations.
- .2 Mount sensors rigidly and adequately for the environment within which the sensor operates.
- .3 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- .4 All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
- .5 Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
- .6 Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m of sensing element for each 1 m² (1 ft. of sensing element for each 1 ft²) of coil area.
- .7 All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

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- .8 Install outdoor air temperature sensors on North wall, complete with sun shield at designated location.

3.10 Flow Switch Installation

- .1 Use correct paddle for pipe diameter.
- .2 Adjust flow switch in accordance with Manufacturer's instructions.

3.11 Actuators

- .1 Mount and link control damper actuators according to Manufacturer's instructions.
 - .1 To compress seals when spring-return-actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the leakage.
 - .2 Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - .3 Provide all mounting hardware and linkages for actuator installation.
- .2 Electric/Electronic:
 - .1 Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following Manufacturer's recommendations.
 - .2 Valves: Actuators shall be connected to valves with adaptors approved by the actuator Manufacturer. Actuators and dampers shall be mounted following the actuator Manufacturer's recommendations.

3.12 Warning Labels

- .1 Permanent warning labels shall be affixed to all equipment that can be automatically started by the DDC system.
 - .1 Labels shall use white lettering (12-point type or larger) on a red background.
 - .2 Warning labels shall read as follows:
C A U T I O N
This equipment is operating under automatic control
and may start or stop at any time without warning.
Switch disconnect to Off position before servicing.
- .2 Permanent warning labels shall be affixed to all motor starters and all control panels that are connected to multiple power sources utilizing separate disconnects.
 - .1 Labels shall use white lettering (12-point type or larger) on a red background.
 - .2 Warning labels shall be read as follows:
C A U T I O N
This equipment is fed from more than one
power source with separate disconnects.
Disconnect all power sources before servicing.

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3.13 Identification of Hardware & Wiring

- .1 All wiring and cabling, including that within factory-fabricated panels, shall be labelled at each end within 5 cm (2 in.) of termination with the DDC address or termination number.
- .2 Permanently label or code each point of field terminal strips to show the instrument or item served.
- .3 Identify control panels with minimum 1 cm (1/2 in.) letters on laminated plastic nameplates.
- .4 Identify all other control components with permanent labels. All plug-in components shall be labelled such that the removal of the component does not remove the label.
- .5 Identify room sensors relating terminal box or valves with nameplates.
- .6 Manufacturer's nameplates and UL or CSA labels are to be visible and legible after equipment is installed.
- .7 Identifiers shall match record documents.
- .8 All wiring and conduit, including wiring within panels, shall be labelled on both ends with the device name or DDC address location or terminal block number.
- .9 All straight runs should be labelled at least every 15 m (50 ft.) and at all junction boxes and branches. A label/tag should be Provided within 1 m (3 ft.) of any penetration of floor, wall, or ceiling. All tags/labels shall be easily read and within view in concealed areas such as ceiling plenums, shafts, and chases.
- .10 All electrical devices such as transformers and power supplies shall be labelled with supply voltage and power circuit number.
- .11 Terminal blocks shall be labelled to match the connected device.
- .12 Panel-mounted devices shall be labelled to match as-built Drawings.
- .13 All wire and tubing labels shall be clearly indicated on the control Drawings. The method of labelling shall be logical and intuitive.

3.14 Controllers

- .1 Provide a separate controller for each AHU or other HVAC system. A DDC controller may control more than one system provided that all points associated with the system are assigned to the same DDC controller. Points used for the control loop reset, such as outside air or space temperature, are exempt from this requirement.
- .2 Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.
 - .1 Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional controller boards or point modules shall be required to implement use of these spare points.

3.15 Programming

- .1 Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.

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- .2 **Point Naming:** System point names shall be modular in design, allowing easy operator interface without the use of a written point index. Use the following naming convention:
- .1 AA, BBB, CCDDE where:
- .1 AA is used to designate the location of the point within the building, such as the mechanical room, wing or level, or the building itself in a multi-building environment.
- .2 BBB is used to designate the mechanical system with which the point is associated (e.g., A01, HTG, CLG, LTG),
- .3 CC represents the equipment or material referenced (e.g., SF for supply fan, RW for return water, EA for exhaust air, ZN for zone),
- .4 D or DD may be used for clarification or for identification if more than one CC exists (e.g., SF10, ZNB),
- .5 E represents the action or state of the equipment or medium (e.g., T for temperature, H for humidity, C for control, S for status, D for damper control, I for current).
- .3 **Software Programming:**
- .1 Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
- .1 Text-based:
- .1 Must provide actions for all possible situations.
- .2 Must be modular and structured.
- .3 Must be commented.
- .2 Graphic-based:
- .1 Must provide actions for all possible situations
- .2 Must be documented
- .3 Parameter-based:
- .1 Must provide actions for all possible situations
- .2 Must be documented
- .4 **Operator Interface:**
- .1 **Standard Graphics:** Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.
- .2 Show terminal equipment information on a graphic summary table. Provide dynamic information for each point shown.
- .3 The Contractor shall provide all labour necessary to install, initialise, start up, and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third party software installation and integration required for successful operation of the operator interface.

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3.16 Control System Checkout & Testing

- .1 **Start-up Testing:** All testing listed in this article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner's representative is notified of the system demonstration.
- .2 The Contractor shall furnish all labour and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
- .3 Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that all terminations are tight.
- .4 Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to Manufacturer's recommendations.
- .5 Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
- .6 Verify that all analog output levels (I/P's, actuators, etc.) are functional, that start and span are correct, and that span and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel.
- .7 Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum start/stop routines.
- .8 Alarms and Interlocks:
 - .1 Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - .2 Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 - .3 Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.17 Trend Logs

- .1 Provide an automatic roll-over trend log, which stores records up to an operator-selected number at an operator-selected sampling rate and then overwrites the oldest records with each new record.
- .2 Provide the capacity to trend log at least one-half of all system points simultaneously.
- .3 Provide tabular displays and a printout of user definable range of points assignable by the operator. A trend log of a single input at a time is not acceptable.

3.18 Communications Requirements

- .1 The remote terminal(s) in the Mechanical Room (as required) shall be able to request values of designated input signals, reset designated values, switch or position designated devices, and receive alarms.
- .2 The BAS system shall be capable of being user-programmed locally and at the terminals.

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- .3 The BAS shall be capable of sending alarm messages to the printer.

3.19 Thermostat Protection & Location

- .1 All thermostats and sensors in unsupervised public use space shall have 7'-0" (2100 mm) mounting height with solid locking covers, locking adjustment, locking stops or heavy plastic locking covers where these features are not available.
- .2 In offices and supervised or personal use space, locate thermostats at 5'-6" (1650 mm) with face thermometers, temperature adjustment and locking stops.

3.20 Control System Demonstration & Acceptance

.1 Demonstration:

- .1 Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
- .2 The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the Control System Checkout and Testing article in Part 3 of this specification. The Consultant will be present to observe and review these tests. The Consultant shall be notified at least 10 days in advance of the start of the testing procedures.
- .3 The demonstration process shall follow that approved in Part 1, Submittals. The approved checklist and forms shall be completed for all systems as part of the demonstration.
- .4 The Contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove proper operation shall be provided by and operated by the Contractor.
- .5 As each control input and output is checked, a log shall be completed showing the date technician's initials, and any corrective action taken or needed.
- .6 Demonstrate compliance with Part 1, System Performance.
- .7 Demonstrate compliance with sequences of operation through all modes of operation.
- .8 Demonstrate complete operation of operator interface.
- .9 Additionally, the following items shall be demonstrated:
- .1 DDC loop response. The Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.

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- .2 Demand limiting. The Contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30 minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
- .3 Optimum start/stop. The Contractor shall supply a trend data output showing the capability of the algorithm. The change of value or change of state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
- .4 Interface to the building fire alarm system.
- .5 Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the Consultant. These logs shall cover three 48 hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.
- .10 Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

.2 Acceptance:

- .1 All tests described in this specification shall have been performed to the satisfaction of the Commissioning Agent, Consultant and Owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the completion requirements if stated as such in writing by the Consultant. Such tests shall then be performed as part of the warranty.
- .2 The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, Submittals.
- .3 Coordinate with the Commissioning Agent regarding testing and demonstration of the BAS system.

3.21 Cleaning

- .1 The Contractor shall clean up all debris resulting from his/her activities daily. The Contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- .2 At the completion of Work in any area, the Contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.
- .3 At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.22 Training

- .1 Provide one (1) on-site training session for four (4) hours, for personnel designated by the Owner.

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- .2 Provide one (1) additional training session at 12 months following building's turnover. The session shall be two (2) hours in length and must be coordinated with the building Owner.
- .3 Train the designated staff of Owner's Representative and Owner to enable them to do the following:
 - .1 Day-to-Day Operators:
 - .1 Proficiently operate the system.
 - .2 Understand control system architecture and configuration.
 - .3 Understand DDC system components.
 - .4 Understand system operation, including DDC system control and optimizing routines (algorithms).
 - .5 Operate the workstation and peripherals.
 - .6 Log on and off the system.
 - .7 Access graphics, point reports, and logs.
 - .8 Adjust and change system set points, time schedules, and holiday schedules.
 - .9 Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
 - .10 Understand system Drawings and Operation and Maintenance manual.
 - .11 Understand the job layout and location of control components.
 - .12 Access data from DDC controllers and ASCs.
 - .13 Operate portable operator's terminals
 - .2 Advanced Operators:
 - .1 Make and change graphics on the workstation.
 - .2 Create, delete, and modify alarms, including annunciation and routing of these.
 - .3 Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user definable time intervals.
 - .4 Create, delete and modify reports.
 - .5 Add, remove and modify system's physical points.
 - .6 Create, modify and delete programming.
 - .7 Add panels when required.
 - .8 Add operator interface stations.
 - .9 Create, delete and modify system displays, both graphical and others.
 - .10 Perform DDC system field checkout procedures.
 - .11 Perform DDC controller unit operation and maintenance procedures.
 - .12 Perform workstation and peripheral operation and maintenance procedures.
 - .13 Perform DDC system diagnostic procedures.
 - .14 Configure hardware including PC boards, switches, communication, and I/O points.
 - .15 Maintain, calibrate, troubleshoot, diagnose and repair hardware.
 - .16 Adjust, calibrate and replace system components.

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- .3 System Managers/Administrators:
 - .1 Maintain software and prepare backups.
 - .2 Interface with job-specific, third party operator software.
 - .3 Add new users and understand password security procedures.
- .4 These objectives will be divided into three logical groupings. Participants may attend one or more of these, depending on level of knowledge required.
 - .1 Day to day Operators: part 1
 - .2 Advanced Operators: parts 1 and 2
 - .3 System Managers/Administrators: parts 1 and 3
- .5 Provide course outline and materials in accordance with the Submittals article in Part 1 of this specification. The instructor(s) shall provide one copy of training material per student.
- .6 The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- .7 Classroom training shall be done using a network of working controllers representative of the installed hardware.

SEQUENCES OF OPERATION

3.23 Exhaust Fan EF-1

- .1 Exhaust fan EF-1 comes complete with a 24V cooling thermostat.
- .2 Section 15900 installs thermostat and wires from thermostat to terminal strip at fan to maintain 24 Deg. C setpoint.
- .3 Provide a room sensor in Elevator Machine Room for room temperature status.

3.24 Boiler Plant

- .1 The Boiler Plant consists of the following:
 - .1 Wall mounted Boiler complete with unit mounted control panel and boiler pump P-1
 - .2 Heating system pump P-2 complete with ECM motor and sensorless control.
- .2 The boiler plant shall be enabled automatically when the outside air temperature falls below a operator adjustable setpoint or manually by the operator. P-2 and boiler status shall be monitored via a current sensor.
- .3 When the plant has been enabled P-1 and P-2 are started and operate continuously. Section 15900 to provide control wiring from Boiler Control Panel to P-1 and P-2. When flow is established in the primary loop and secondary loops as indicated by their respective flow switches then the boilers are energized according to their temperature schedule. P-2 shall modulate speed to maintain system.
- .4 If a no flow condition is indicated by the primary loop flow switch then an alarm is initiated at the BAS.
- .5 If a no flow condition is indicated by the main heating system secondary loop flow switch then the lead pump is stopped & the lag pump is started. Every seven days the lead & lag pumps will be alternated.

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- .6 The boiler is complete with its own operating and safety controls.
- .7 The Boiler panel shall control supply water temperature and based on the following reset schedule

Outside Air Temperature	Supply Water Temperature
-15 Deg. C	82 Deg. C
+15 Deg. C	54 Deg. C

- .8 Section 15900 shall install and wire outdoor sensor to Boiler Control Panel. Sensor by Boiler Supplier.

3.25 Radiant Panels & Wallfins

- .1 The 2-way modulating control valves serving the radiant panel and wallfins shall be controlled by a room sensor to maintain the desired setpoint of the corresponding space. Contractor to connect sensor and valve to nearest terminal controller with available capacity or Provide an additional terminal controller as required. Room sensor to be complete with local setpoint adjustment feature and night setback control.
- .2 A complete system status, setpoint adjustments, time schedules and alarms are all be reporting to the Building Automation System for viewing and adjustment.
- .3 See plans for locations of radiant panels and wallfins.
- .4 Install room sensors in modular control panel in each Classroom. Sensors in washrooms and other public areas shall be complete with guards.

3.26 Outdoor Building Lighting

- .1 The BAS shall interface to the lighting contactors controlling the exterior lighting located in Room 154A. The BAS shall control exterior lighting via clock function in the BAS.

3.27 Electronic Plumbing Fixtures

- .1 Division 16 shall supply 120V/1 ph. power to a junction box in the ceiling space of each Washroom Group.
- .2 Section 15900 shall supply and install 120V/24V stepdown transformer at each junction box and install 24V wiring from transformer to each plumbing fixture.

3.28 IT Room

- .1 The system consists of the following:
 - .1 Indoor Fan Coil Units FCU-1 complete with fan coil controller
 - .2 Outdoor condenser CU-1
- .2 The sequence of controls is, as follows:
 - .1 Section 15900 installs and mounts fan coil controller at fan coil. Fan coil controller supplied and installed by Fan Coil Supplier.
 - .2 Section 15900 shall Provide control wiring between the controller, fan coil and condenser. Confirm type of wiring with Fan Coil Supplier.
 - .3 Fan coil shall cycle On/Off to maintain the controller setpoint.
 - .4 The BAS shall install and wire a room sensor into the IT Room to provide independent room temperature status.

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3.29 Energy Recovery Ventilator ERV-1

- .1 The unit consists of the following:
 - .1 Outside air damper
 - .2 Outdoor air filter section
 - .3 Enthalpy wheel complete with VFD
 - .4 Enthalpy wheel bypass damper
 - .5 Supply Fan complete with VFD
 - .6 Gas-fired heating section with modulating heating valves
 - .7 DX cooling section complete with 4-stages of cooling
 - .8 Return air filter section
 - .9 Return air fan complete with VFD.
 - .10 Sanitary exhaust fan
 - .11 Exhaust air damper
 - .12 BACnet interface module
- .2 The unit shall run based upon an operator adjustable schedule.
- .3 Occupied Period:
 - .1 Upon unit start-up, the outside and exhaust air dampers open.
 - .2 End switch on dampers allows supply fan, return fan and sanitary exhaust fans to start and run continuously.
 - .3 The economizer enthalpy wheel, heating section and cooling section maintain discharge air setpoint.
 - .4 Freezestat to shut down unit at 5 Deg. C.
 - .5 Firestat to shut down unit at 40 Deg. C.
- .4 Unoccupied Periods:
 - .1 During unoccupied periods the fans are Off and the outdoor air and exhaust dampers are Closed.
- .5 The unit shall shut down and generate an alarm upon receiving a freezestat status.
- .6 Supply Fan:
 - .1 The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties.
- .7 Return Fan/Sanitary Exhaust Fan:
 - .1 The return fan and sanitary exhaust fan shall run whenever the supply fan runs.
 - .2 The return fan VFD and sanitary exhaust fan shall modulate in unison with the supply fan VFD.
- .8 Enthalpy Recovery Wheel:
 - .1 The air handling equipment factory control shall control the enthalpy wheel during cooling and heating operation, frost protection, and periodic self-cleaning.
 - .2 The controller shall measure the following for the enthalpy wheel:
 - .1 Discharge air temperature

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- .2 Discharge air humidity
- .3 Return air temperature
- .4 Return air humidity
- .3 The enthalpy wheel shall run for full recovery whenever:
 - .1 The outside air enthalpy is greater than the return air enthalpy when the unit is in cooling mode
 - .2 The outside air enthalpy is less than the return air enthalpy when the unit is in heating mode
 - .3 The supply and Return fans are ON
 - .4 The by-pass dampers are closed
 - .5 Economizer mode is OFF
- .4 The enthalpy wheel bypass dampers shall open whenever the enthalpy wheel is disabled.
- .9 Supply Air Temperature:
 - .1 At outdoor air temperatures below 20 Deg. C, the controller shall monitor supply air temperature and shall maintain the following supply air temperatures:
 - .1 Above 20 Deg. Cooling: The setpoint shall be reset based on the average room temperatures as sensed by the Classroom room sensors.
 - .2 Heating: At outside air temperature below 20 Deg. C, the supply air temperature shall operate on the following reset schedule:

Outside Air Temperature	Supply Air Temperature
15 Deg. C	18 Deg. C
-15 Deg. C	24 Deg. C
- .10 Economizer:
 - .1 The controller shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F (adj.) less than the supply air temperature setpoint. The outside air dampers shall maintain a minimum adjustable position as measured by the air balancing contractor (adj.) open whenever occupied.
 - .2 The economizer shall be enabled whenever:
 - .1 Outside air temperature is between 15 Deg. C and 20 Deg. C
 - .2 AND the outside air enthalpy is less than 22 BTU/lb (adj.)
 - .3 AND the outside air temperature is less than the return air temperature.
 - .4 AND the outside air enthalpy is less than the return air enthalpy.
 - .5 AND the supply fan status is on.
 - .6 The enthalpy wheel is OFF and by-pass dampers are open
 - .3 The economizer shall close whenever:
 - .1 Mixed air temperature drops from 40°F to 35°F (adj.)
 - .2 OR the freezestat is on.
 - .3 OR on loss of supply fan status.
 - .4 The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off.

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- .11 Connect to BACnet interface module to provide data stream to BAS.

3.30 Control Valve Installation

- .1 Valve submittals shall be coordinated for type, quantity, size and piping configuration to ensure compatibility with pipe design.
- .2 Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.
- .3 Valves shall be installed in accordance with the Manufacturer's recommendations.
- .4 Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
- .5 Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at all connections to screw-type control valves.
- .6 Provide tags for all control valves indicating service and number. Tags shall be brass, 1.5 inch in diameter, with 1/4 inch high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop Drawings.

3.31 Start-Up & Checkout Procedures

- .1 Start up, check out, and test all hardware and software and verify communication between all components.
- .2 Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
- .3 Verify that all analog and binary input/output points read properly.
- .4 Verify alarms and interlocks.
- .5 Verify operation of the integrated system.

[illegible]

FAILURE MODE:

C-LAST COMMAND
O-ON (OPEN)

H-HIGH LEVEL
F-OFF (CLOSED)

L-LOW LEVEL
N-LOCAL LOOP

[illegible]

FAILURE MODE:

C-LAST COMMAND
O-ON (OPEN)

H-HIGH LEVEL
F-OFF (CLOSED)

L-LOW LEVEL
N-LOCAL LOOP

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.

1.2 Scope of Work

- .1 Equipment shall be supplied to meet the performance requirements shown on the equipment plans and Specifications. To comply with job site constraints and/or freight restrictions, the units shall be shipped, fully assembled, in modules, or knocked down, ready for field installation. Shipping details shall be coordinated and included with submittal Drawings.
- .2 Prior to shipping the units from the factory, the units may be inspected by the Consultant, Owner or a representative assigned by the Owner and the Prime Mechanical Contractor.
- .3 The Prime Mechanical Contractor shall be responsible for inspecting the units upon arrival at the job-site or riggers yard. Any deficiencies and/or freight damage shall be documented to the factory within 24-hours. Rigging, installation, sealing of modules and field start-up Work shall be executed by the Mechanical Contractor as outlined in the Project Specifications.
- .4 The Manufacturer shall warranty the equipment, parts and labour, for a period of one (1) year commencing at the date of Substantial Completion of the Project.

1.3 References

- .1 Conform the latest edition, including Amendments of the following Codes and Standards.
- .2 ARI 880
- .3 ARI 410, Forced-circulation air cooling and air heating coils
- .4 ASHRAE 62, Ventilation for acceptable indoor air quality
- .5 ASTM A525, Steel sheet, zinc coated by hot-dip process
- .6 ASTM E90
- .7 NEMA MG1, National electrical manufacturers association (Motors and generators)
- .8 NFPA 70, National fire protection code
- .9 NFPA 90
- .10 OSHA, Occupational safety and health administration
- .11 SMACNA, HVAC metal duct association
- .12 UL 900, Underwriters laboratory, (test performance of air filters quality)
- .13 Equipment schedules shown on Drawings and Specifications.

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1.4 Quality Assurance

- .1 The following parameters define the selection criteria and are to be as specified: airflow rates, external static pressures, water flow rates, electrical power supply. The following parameters are to be as specified or improved upon: coil face velocity, filter velocities, internal static pressure losses, electrical power consumption, discharge/inlet and radiated sound power levels.
- .2 The units shall be produced by a Manufacturer whose design and processes are thoroughly documented and verifiable. The quality control program shall ensure the consistency of the Product and the effectiveness of the production processes.
- .3 Components must be sourced from well recognized Manufacturers whose Products comply with their Product-specific industry standards.
- .4 The Contractor shall be a licensed Refrigeration Contractor who is a registered member of the Canadian Refrigeration, Air-Conditioning Contractors' Association.
- .5 Filter media shall be UL listed.

1.5 Delivery, Storage & Handling

- .1 The units shall be thoroughly cleaned and inspected prior to shipping.
- .2 The units must be handled carefully in the field to avoid damaging internal components, cabinet walls and the exterior finish.
- .3 Store the units in a dry, clean environment protected from the outdoor weather.
- .4 The units must not be operated, for temporary or permanent purposes, until the official start-up is completed by the Mechanical Contractor and witnessed by a Manufacturer's representative.

1.6 Bidding Instructions

- .1 This Section will be bid directly to the Mechanical Contractor.

1.7 Related Work Specified Elsewhere

.1	Testing, Adjusting & Balancing:	Section 15013
.2	Basic Materials & Methods:	Section 15050
.3	Insulation:	Section 15180
.4	Plumbing & Drainage:	Section 15400
.5	Air Distribution:	Section 15800
.6	Controls & Instrumentation:	Section 15900

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.
- .2 Conform to Refrigeration - General Provisions, Section 15950.

1.2 Related Work Specified Elsewhere

- .1 Basic Materials & Methods: Section 15050

PART 2 - PRODUCTS

2.1 Refrigerant Piping

- .1 All materials used in the construction and installation of the Refrigeration System shall be suitable for the refrigerant used and no material shall be used that will deteriorate due to the chemical action of the refrigerant and oil. Refrigerant piping is to be type ACR copper; fittings are drawn or machined; cast fittings are not acceptable; joints are silver soldered or brazed using a high temperature solder, equal to Silfos.
- .2 Each pressure vessel which may be shut off by stop valves from other parts of the system shall be protected by an approved pressure relief valve piped to the outdoors.
- .3 **Filter Drier:** On lines 3/4" (20 mm) O.D. and larger, filter drier shall be replaceable core type with non-ferrous casing with a Schraeder type valve. On lines smaller than 3/4" (30 mm) O.D., filter drier shall be a sealed type using male flare fittings. Size shall be full line size. Filter drier shall be Sporlan, Mueller or Asco.
- .4 **Sight Glass:** A combination moisture and liquid indicator with protection cap. Sight glass shall be Also, Mueller, Sporlan or Henry. Size shall be full line size.
- .5 **Solenoid Valve:** Full liquid line size, normally closed, direct acting type with manual opening stem and shall be completely moisture proof. Valve shall be Asco, Sporlan or Singer.
- .6 **Manual Shut-Off Valves:** For refrigeration service with back seating construction and cap seals. Valves with hand wheels are not acceptable. For valves 3/8" through 5/8" (9.5 through 15.9 mm) size, use male flare fittings. Valves shall be Mueller or Henry. Provide service valve on each liquid and suction line at compressor. If service valves come as an integral part of the condensing unit, additional service valves are not required.
- .7 **Refrigerant Valves:** All freon refrigerant valves shall be back seating globe valves, packed or diaphragm packless. Winged-type sealed caps are to be used. Valves are to be brass. Angle valves are preferred; check valves are to be used where required. Relief valves shall be Provided where required with the vent piped to outdoors. Straight through valves shall be installed with stems horizontal to facilitate drainage.
- .8 VRV Manufacturer shall Provide Refnet® header and joint sections as determined by the Vendor's engineered design. Provide to Contractor for installation.

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PART 3 - EXECUTION

3.1 Piping

- .1 Refrigerant piping shall be hung from cushion clamps, secured to unistrut, hung from threaded hanging rods. Minimum length of hanging rods to be 12" (300 mm). Install neoprene cover around pipe to prevent vibration and wear.
- .2 Install filter, dryer, sight glass and thermal expansion valve on each system.
- .3 Hot gas lines to be complete with oil traps.
- .4 Piping outdoors to be mounted on roof sleepers. See Typical Piping Roof Support Detail on Mechanical Drawings. Provide neoprene cover to eliminate vibration and wear.
- .5 Insulate liquid and suction lines with 1/2" (15 mm) Armaflex II pipe insulation sealed at joints with Armstrong 520 adhesive.
- .6 Piping to be tested with nitrogen to 400 psig (2760 kPa) for four (4) hours and leaks repaired before insulation is applied.
- .7 VRV Refrigeration pipe systems to be tested with nitrogen to 550 psig (3800 kPa) for twenty-four (24) hours and leaks repaired and piping retested before insulation is applied.
- .8 Roof pipe sleeve shall be supplied by Division 15 and installed by the General Contractor. Co-ordinate with Division 15.
- .9 Roof pipe sleeve shall be supplied by and installed by the Owner approved Roofing Consultant/Contractor. Co-ordinate with Division 15.
- .10 After Refrigerant pipe installation is complete and tested, supply and charge each system with the correct quantity of oil and refrigerant.

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PART 1 - GENERAL

1.1 Related Instructions

- .1 Conform to General Provisions, Section 15010.
- .2 Conform to Refrigeration - General Provisions, Section 15950.

1.2 Related Work Specified Elsewhere

- .1 Basic Materials & Methods: Section 15050
- .2 Electrical Work: Division 16

1.3 Submittals

- .1 Submit Shop Drawings in accordance with Section 15011 for the following equipment:
 - .1 Fan Coil Units
 - .2 Condensing Units

PART 2 - PRODUCTS

2.1 Ductless Split System

- .1 Manufacturers:
 - .1 Design is based on: Daikin, distributed by DXS (HTS)
 - .2 Acceptable Products
 - .1 Daikin
 - .2 Mitsubishi
 - .3 LG
 - .4 Hitachi
 - .5 Samsung
- .2 **General:**
 - .1 This section includes the design, performance, refrigerant details, controls and installation requirements for Daikin ductless split system by DXS (an HTS company, 416-661-3400)
 - .2 All units shall be listed and rated by ANSI/AHRI Standard 1230-2010 and meet all minimum IEER performance requirements as scheduled
 - .3 The units shall be CSA approved, ANSI/UL STD 1995 listed and listed by Electrical Laboratories (ETL) and bear the cETL label.
 - .4 All wiring shall be in accordance with the National Electric Code (NEC).
 - .5 The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
 - .6 The units and the design shall be in compliance with CSA B52 Mechanical Refrigerant Code.

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.3 System Description:

- .1 The variable capacity air conditioning system shall be a Daikin Inverter Driven heat pump split system as specified. The system shall consist of an indoor evaporator exclusively matched to an outdoor variable speed rotary compressor condensing unit.
- .2 The outdoor unit shall be configured for horizontal discharge airflow and complete with a variable speed condenser fan using a single phase power supply.
- .3 Provide an ultra-low ambient kit and wind baffles to permit unit operation in cooling mode down to -40°F.
- .4 The system shall be designed to operate with a maximum refrigerant pipe length of 66 feet, with 49 feet maximum vertical difference, and without any oil traps or additional equipment. Refrigerant shall be R-410A.

.4 Refrigerant Piping:

- .1 Refer and comply to the refrigerant piping specifications, including the special considerations for VRF refrigerant piping section.

.5 Fan Coils:

- .1 The indoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. Both liquid and suction lines must be individually insulated between the outdoor and indoor units.
- .2 The indoor unit shall have a white, "flat screen" finish.
- .3 The drain and refrigerant piping on wall mounted units shall be accessible from six (6) positions for flexible installation (right side, right back, and right bottom; and left side, left back, and left bottom).
- .4 The cabinet shall include an "intelligent-eye" motion sensor capable of setting back the set point temperature for energy savings. This feature may be disengaged on the wireless remote controller.
- .5 The evaporator fan shall be statically and dynamically balanced. Motor shall have permanent lubricated bearings and offer up to five speed settings.
- .6 Auto-swing louver shall automatically adjustable the air flow pattern (both vertically and horizontally).
- .7 The filter shall be mildew proof, washable.
- .8 The evaporator coil shall be nonferrous, with aluminum fin on a copper tube heat exchanger. All tube joints shall be brazed with silver alloy or phoscopper. All coils shall be factory pressure tested. A condensate pan shall be provided under the coil with a drain connection.
- .9 Provide a condensate pump (shipped loose) for field installation.

.6 Condensing Unit:

- .1 The outdoor unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.
- .2 The fan shall be a direct drive, propeller type fan. The motor shall be inverter driven with permanently lubricated bearings
- .3 A fan guard shall be provided on the outdoor unit to prevent contact with fan operation.
- .4 The outdoor coil shall have nonferrous construction with a corrugated fin tube.

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- .5 The compressor shall be a Daikin rotary swing inverter-driven compressor. Compressor safeties shall include internal thermal overload protection. Refrigeration specialties shall include an accumulator, refrigerant metering device and a four-way reversing valve.
- .7 **Controls:**
 - .1 The unit shall be supplied with Individual Zone Controller, similar to Daikin model BRC944B2.
 - .2 Remote controllers shall be hard wired by installing contractor.
 - .3 Controllers shall be able to function as follows:
 - .4 An LCD digital display will allow the temperature to be set in 1°F or 1°C units.
 - .5 The controller shall be equipped with a thermostat sensor.
 - .6 The controller shall have the ability to automatically changeover the mode of operation.
 - .7 Selectable auto/cool/heat/dry operation modes with adjustable temperature and airflow rates.
 - .8 Controller shall have one time or daily timer functionality with up to 2 timer actions per day.
- .8 **Electrical:**
 - .1 The outdoor unit shall be powered with 208-230 volts, 1 phase, 60 hertz power. The indoor unit shall receive 208-230 volt, 1 phase, 60 hertz power fed from the outdoor unit.
- .9 **Start-Up & Warranty:**
 - .1 The system must be installed by an authorized contractor/dealer.
 - .2 The manufacturer shall provide a factory trained service technician to start-up each unit. Untrained contractors who wish to bid this project may contact DXS (416-661-3400) to arrange training prior to bid day. Manufacturer shall provide instruction to the Owners personnel on proper unit operation and maintenance.
 - .3 The warranty period shall commence on the date of initial start-up and shall continue for a period of ten (10) years not to exceed eighteen (18) months from date of shipment.

PART 3 - EXECUTION

3.1 Ductless Split System

- .1 Fully pipe up evaporator and associated air cooled condenser unit as per Manufacturers installation instructions.
- .2 After the refrigerant pipe installation is complete and tested, supply and charge each system with correct quantity of oil and refrigerant.
- .3 Section 15951 to supply and install the refrigerant piping: leak test piping; evacuate the pipework; charge the system with additional refrigerant; and connect control wiring to indoor and condensing units. The installing Contractor shall be required to attend Manufacturer's training and submit training certification proof.
- .4 The VRV system Manufacturer to provide training to installing Contractor, and provide CAD Drawing of all refrigerant piping complete with connections, transitions, REFNET joint locations, and sizes. Manufacturer to include joints as required in the Tender Price.

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- .5 Refrigerant piping shall be hung from cushion clamps, secured to unistrut, hung from threaded hanging rods. Minimum length of hanging rods to be 12" (300 mm). Install neoprene cover around pipe to prevent vibration and wear. Cushion clamps are to be loosely secured to refrigerant pipe to allow for expansion/contraction. Do not secure unistrut directly to interior walls or underside of concrete structural slab.
- .6 Supply and install every 50'-0" (15000 mm) in the refrigeration piping system, an expansion loop. Supply and install pipe anchors where noted on the Drawings.
- .7 Section 15400 shall pipe the drain pan to drain with trap. Provide interlock relay between condenser and remote fan coil units. Each system shall be complete with programmable wall mounted thermostat.
- .8 Division 16 will wire power to each fan coil unit and condensing unit. Section 15900 is to Provide control wiring from each fan coil unit to condensing unit. Section 15900 is to run controls to operate the fan and cooling. 15900 to install and wire programmable thermostat/controller.
- .9 This Section shall secure all outdoor condensing units to the concrete slab, resting on the roof.
- .10 Refrigerant piping and condensate drainage piping shall be installed concealed within building structure. Pipe is not to run exposed.
- .11 Contractor to ensure that outdoor air cooled condensing units are elevated a minimum of 18".
- .12 Contractor to contact Manufacturer with any changes to pipe lengths or locations and receive revised piping and wiring diagrams which will be used for sizing pipe diameters and calculating refrigerant charge.
- .13 Contractor to confirm final location of condensing units.
- .14 Contractor to schedule a site meeting with Manufacturer's technician prior to beginning piping installation. Manufacturer may request to schedule a site visit to verify installation methods are in accordance with Manufacturer requirements.
- .15 Control wiring is 18 AWG, 2 wire stranded, non-shielded for the entire system (control wiring between the fan coils and stats). No exception.
- .16 Contractor to pressure test system with the following procedure: 150 psi for 3 minutes, then 325 psi for 3 minutes, then 550 psi for 24 hours. Following the pressure test, the system is to be vacuumed/dehydrated to 500 microns and held in a vacuum for 12 hours.
- .17 Contractor is to insulate both the suction and liquid refrigerant lines.
- .18 Refrigerant charge is to be calculated by the Manufacturer as per the actual installed pipework.



Waterloo Catholic District School Board

Grguric Architects Inc.

Type of Document:

Electrical Specifications Issued for Tender

EXP Project:

ALL-25004500-A0

St. Aloysius Catholic Elementary School - Addition

504 Connaught St, Kitchener ON N2C 1C2

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2026-02-13



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PART 1 - GENERAL

1.1 References

- .1 Division 00 and Division 01 apply to and are a part of this Section.

1.2 Application

- .1 This Section specifies requirements that are common to Electrical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. Where requirements of this Section contradict requirements of Divisions 00 or 01, conditions of Division 00 or 01 to take precedence.
- .2 Be responsible for advising product vendors of requirements of this Section.

1.3 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 cables, 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 including back boxes and exposed piping and raceways; and 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 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 "Mechanical Divisions" - refers to Division 15 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.

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- .11 "Electrical Divisions" - refers to Division 16 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.
- .12 "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.
- .13 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" in Contract Documents.
- .14 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.

1.4 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 16 Division Sections 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 Specification 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 Electrical 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 materials. 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 scope of work and do not show architectural and structural details. Provide fittings, offsets, transformations and similar items required as a result of obstructions and other architectural and/or structural details but not shown on Drawings.
- .8 Locations of equipment and materials shown may be altered, when reviewed by Consultant, to meet requirements of equipment and/or materials, other equipment or systems being installed, and of building, all at no additional cost to Contract.
- .9 Specification does not generally indicate specific number of items or amounts of material required. Specification is intended to provide product data and installation requirements. Refer to schedules, Drawings (layouts, riser diagrams, schematics, details) and Specification to provide correct quantities. Singular may be read as plural and vice versa.

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- .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 of Mechanical Divisions specifications and drawings, 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 are prepared solely for use by party with whom Consultant has entered into a contract and there are no representations of any kind made by Consultant to any other party.
- .12 In case of discrepancies or conflicts between Drawings and Specifications, Documents will govern in order specified in "General Conditions", however, when scale and date of Drawings are same, or when discrepancy exists within Documents, include most costly arrangement.

1.5 Metric & 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. Exact measurements to be confirmed based on application. Where measurements are related to installation and on-site applications, confirm issued document measurements with applicable local code requirements, and/or as applicable, make accurate measurements on site. Where significant discrepancies are found, immediately notify Consultant for direction.

1.6 Examination of Bid Documents & 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.

1.7 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 Consultant.
- .3 Supplementary mandatory Specifications and requirements to be used in conjunction with project include, but are not limited to, the following:
 - .1 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE);

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- .2 American Standards Association (ASA or ANSI);
- .3 Canadian Standards Association (CSA);
- .4 CSA Z432, "Safeguarding of Machinery";
- .5 CSA Z462, "Workplace Electrical Safety";
- .6 Electrical and Electronic Manufacturers Association of Canada (EEMAC);
- .7 Electrical Safety Authority (ESA);
- .8 Electronic Industries Association (EIA);
- .9 Illuminating Engineering Society (IES);
- .10 Institute of Electrical and Electronic Engineers (IEEE);
- .11 National Building Code of Canada (NBC);
- .12 National Electrical Manufacturers Association (NEMA);
- .13 National Fire Protection Association (NFPA);
- .14 Occupational Health and Safety Act (OHSA);
- .15 Ontario Building Code (OBC);
- .16 Ontario Electrical Safety Code (OESC);
- .17 Technical Standards and Safety Authority (TSSA);
- .18 Telecommunications Industry Association (TIA);
- .19 Underwriters Laboratories of Canada (ULC);
- .20 Material Safety Data Sheets by product manufacturers;
- .21 local utility inspection permits;
- .22 Codes, Standards, and Regulations of local governing authorities having jurisdiction;
- .23 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 recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer 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 by Consultant at any time.
- .9 Experienced and qualified superintendent is to be on-site at times when work is being performed.

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- .10 Coordinate work inspection reviews and approvals with governing inspection department to ensure that construction schedule is not delayed. Be responsible for prompt notification of deficiencies to Consultant and submission of reports and certificates to Consultant.
- .11 Properly protect equipment and materials on site from damage due to elements and work of trades, to satisfaction of Consultant. Equipment and materials are to be in new condition upon Substantial Performance of the Work.

1.8 Permits, Certificates, Approvals & Fees

- .1 Contact and confirm with local authorities having jurisdiction including utility providers, requirements for approvals from such authorities.
- .2 Submit required applications, shop drawings, electrical distribution system protection device coordination studies, and short circuit calculations, and any other information requested by local authority.
- .3 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.
- .4 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.
- .5 Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities.
- .6 Where electromagnetic locks are provided whether by this Division or by others, be responsible for obtaining and paying for required certificates of work with regards to such electromagnetic lock work.

1.9 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.

1.10 Planning & 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;

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- .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 As confirmed with Consultant, Mechanical Contractor is to determine final locations of major work within ceiling spaces.
- .4 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.
- .5 Do not use Contract Drawing measurements for prefabrication and layout of raceways, conduits, ducts, bus ducts, luminaires, and other such work. Locations and routing are to be generally 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.
- .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 Control products, products 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.
- .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.
- .9 Where drawings indicate that acoustic tile ceiling is being suspended below plaster ceiling, coordinate design of framework used to support suspended ceiling, lighting, diffusers, and other Divisions components that are mounted within or through ceiling. Do not mount devices to suspended ceiling. Secure and mount to ceiling slab above. Seal ceiling openings to maintain required fire rating.

1.11 Coordination of Work

- .1 Review Contract Documents and coordinate work with work of each trade. Coordination requirements are to include, but not be limited to following:
 - .1 requirements for openings, sleeves, inserts and other hardware necessary for installation of work;

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- .2 concrete work such as housekeeping pads, sumps, bases, etc., required for work, and including required dimensions, operating weight of equipment, location, etc.;
- .3 depth and routing of excavation required for work, and requirements for bedding and backfill;
- .4 wiring work required for equipment and systems but not specified to be done as part of mechanical work, including termination points, wiring type and size, and any other requirements.
- .2 Ensure materials and equipment are delivered to site at proper time and in such assemblies and sizes so as to enter into building and be moved into spaces where they are to be located without difficulty.
- .3 Wherever possible, coordinate equipment deliveries with manufacturers and/or suppliers so equipment is delivered to site when it is required, or so it can be stored within building subject to available space as confirmed with Owner and 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.

1.12 Component Final Locations

- .1 Owner and Consultant reserve right to relocate electrical components such as receptacles, switches, communication system, outlets, hard wired outlet boxes and luminaries at a later date, but prior to installation, without additional cost to Owner, if relocation per components do not exceed 3 m (10') from original location. No credits will be anticipated where relocation per components of up to and including 3 m (10') reduces materials, products and labour. Should relocations exceed 3 m (10') from original location, adjust contract price for that portion beyond 3 m (10') in accordance with provisions for changes in Contract Documents.

1.13 Systems Coordination

- .1 Be responsible for and perform specific coordination of various low voltage systems supplied by Electrical Divisions and also with systems supplied by other Divisions of Work. Include for but not be limited to provision of following, as applicable:
 - .1 coordinate with General Contractor and other Subcontractors, various systems of trades which in any way are interfaced with or monitored by or integrated to, or need to be coordinated with;
 - .2 prepare systems coordination drawings detailing related system coordination and integration points being monitored and/or controlled; submit coordination drawings as part of shop drawing submission;

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- .3 coordinate security system requirements with successful door hardware supplier and prepare detailed coordination drawings of component installations, wiring and conduit layouts, division of responsibility between various trades, etc.; review security system requirements with associated door hardware (electromagnetic locks, electric strikes, etc.), to ensure proper sequence of operation and door functionality is provided to suit each door configuration; prepare detailed door functionality of each door configuration and submit for review by Consultant;
- .4 review systems requirements for component back boxes and conduits; ensure that system of conduits and boxes meet respective system wiring bending radii requirements;
- .5 review specifications of each trade/Division (i.e. for BAS points, elevator requirements, electrical devices in millwork or prefabricated service consoles, outlet box and back box requirements), to ensure proper power supplies, interconnecting wiring requirements and back box/ outlet box requirements;
- .6 review with manufacturers coordination and integration requirements of their systems;
- .7 review each systems communication protocols to ensure they are compatible and can communicate with each other as required;
- .8 review system shop drawings prior to submission to Consultant, to verify that each system has been coordinated with other systems and that required options and features are selected to meet coordination requirements;
- .9 be present at testing and commissioning functions of each system and provide technical assistance with regards to system operations;
- .10 be "on-site" coordinator of respective system trades with regards to respective system coordination of installation and testing;
- .11 coordinate with Consultant with regards to ensuring that systems coordinate and integrate properly to satisfaction of Owner;
- .12 document coordination and integration requirements and maintain records for submission as part of shop drawings;
- .13 respond to coordination and integration requirements and be responsible for such work;
- .14 where a system integrator has been included for, coordinate integration requirements with system integrator.

1.14 Products

- .1 Be responsible for ordering of products (equipment and materials) in a timely manner in order to meet project-scheduling timelines. Failure to order products to allow manufacturers sufficient production/delivery time to meet project-scheduling timelines is an unacceptable reason to request for other suppliers or substitutions.

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- .2 Provide Canadian manufactured products wherever possible or required and when quality and performance is obtainable at a competitive price. Products are to be supplied from manufacturer's authorized Canadian representative, unless otherwise noted. Unless otherwise specified, products are to be new and are to comply with applicable respective Canadian standards. References to UL listings of products to include requirements that products are to be also Underwriters Laboratories of Canada (ULC) listed for use in Canada. Products are to meet or exceed latest ANSI/ASHRAE/IES 90.1 standards, as applicable. Do not supply any products containing asbestos materials or PCB materials.
 - .3 Systems and equipment of this Project are to be "State of the Art" and be most recent and up to date series/version of product that is available at time of shop drawing review process. Products that have been stored or "on shelf" for an extended period of time will not be accepted. Software is to be of latest version available and be provided with updates available at time of shop drawing review process. Systems are to be designed such that its software is backwards compatible. Future upgrades are not to require any hardware replacements or additions to utilize latest software.
 - .4 Products scheduled and/or specified have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In most cases, base specified manufacturers are stated for any product specified by manufacturer's name and model number. Where acceptable manufacturers are listed, first name listed is base specified company. Bid Price may be based on products supplied by any of manufacturers' base specified or named as acceptable for particular product. If acceptable manufacturers are not stated for a particular product, base Bid Price on product supplied by base specified manufacturer.
 - .5 Documents have been prepared based on product available at time of Bidding. If, after award of Contract, and if successful manufacturer can no longer supply a product that meets base specifications, notify Consultant immediately. Be responsible for obtaining other manufacturers product that complies with base specified performance and criteria and meets project timelines. Proposed products are subject to review and consideration by Consultant and are considered as substitutions subject to a credit to Contract. In addition, if such products require modifications to room spaces, mechanical systems, electrical systems, etc., include required changes. Such changes are to be submitted in detail to Consultant for review and consideration for acceptance. There will be no increase in Contract Price for revisions. Above conditions supplement and are not to supersede any specification conditions in Division 01 with regards to substitutions or failure to supply product.
 - .6 Listing of a product as "acceptable" does not imply automatic acceptance by Consultant and/or Owner. It is responsibility of Contractor to ensure that any price quotations received and submittals made are for products that meet or exceed specifications included herein.

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- .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 products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are accepted in writing by Consultant.
- .9 Where products are listed as "or approved equal", certify in writing that product to be used in lieu of base specified product, at least meets space, power, design, energy consumption, and other requirements of base specified product and is equivalent or better than base specified product. When requested by Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equal" products is at sole discretion of Consultant. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of approved equal product. There must be no increase in Contract price due to Consultant's rejection of proposed equivalent product.
- .10 Whenever use of product other than base specified product is being supplied, ensure corresponding certifications and product information (detailed catalogue and engineering data, fabrication information and performance characteristics) are submitted to Consultant for review. Failure of submission of these documents to Consultant in a timely manner to allow for review will result in base specified product to be supplied at Consultant's discretion, at no additional cost to Contract.
- .11 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable may be considered for acceptance by Consultant if requested in writing with full product documentation submitted, a minimum of 10 working days prior to Bid closing date.
- .12 Any proposed changes initiated by Contractor after award of Contract may be considered by Consultant at Consultant's discretion, with any additional costs for such changes if approved by Consultant, and costs for review, to be borne by Contractor.

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- .13 Whenever use of product other than based specified products or named as acceptable is being supplied, allow sufficient time for processing of product submissions and time for Consultant's review, such that there will not be significant impact on contract time or work schedule.
- .14 Requirements for low voltage systems of this project that are of technology that changes rapidly and are forever evolving and changing, resulting in systems that may be out dated by time of installation, are to include provisions to allow Owner option to select most updated technology. Shop drawings for such systems and equipment are to include provisions for a minimum 6-week review time for Owner to review degree of technology of each system and determine acceptance. Owner will have right to substitute a more advanced technology subject to negotiated pricing.

1.15 Shop Drawings

- .1 At start-up meeting confirm with Consultant, products to be included in shop drawing submission. Prepare and submit list of products to Consultant for review.
- .2 Submit electronic copies of shop drawings unless otherwise directed by Consultant. Confirm exact requirements with Consultant.
- .3 Submit for review, drawings showing in detail design, construction, and performance of equipment and materials as requested in Specification. 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;

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- .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 shop drawing review stamp applied to each and every shop drawing submitted:
- .9 "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 CO-ORDINATION OF WORK OF SUB-TRADES."
- .10 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.
- .11 Obtain shop drawings for submission from product manufacturer's authorized representatives and supplemented with additional items specified herein.
- .12 Do not order product until respective shop drawing review process has been properly completed by Consultant.
- .13 Where extended warranties are specified for equipment items, submit specified extended warranty with shop drawing submittal.
- .14 Refer to specific requirements in other Sections.

1.16 Equipment Loads

- .1 Supply equipment loads (self-weight, operating weight, housekeeping pad, inertia pads, etc.) to Consultant, via shop drawing submissions, prior to construction.
- .2 Where given choice of specific equipment, actual weight, location and method of support of equipment may differ from those assumed by Consultant for base design. Back-check equipment loads, location, and supports, and include necessary accommodations.
- .3 Where supporting structure consists of structural steel framing, it is imperative that equipment loads, location, and method of support be confirmed prior to fabrication of structural steel. Be responsible for confirming locations of equipment with Consultant prior to construction.

1.17 Openings

- .1 Supply opening sizes and locations to Consultant to allow verification of their effect on design, and for inclusion on structural drawings where appropriate.
- .2 No openings are permitted through completed structure without written approval of Consultant. Show required openings on a copy of structural drawings. Identify exact locations, elevations, and size of proposed openings and submit to Consultant for review, well in advance of doing work.

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- .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 coordinated with Consultant, do not leave any openings unprotected and unfinished overnight.

1.18 Scaffolding, Hoisting, & 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 of 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 Consultant.

1.19 Changes In The Work

- .1 Whenever Consultant proposes in writing to make a change or revision to design, arrangement, quantity, or type of any work from that required by Contract Documents, prepare and submit to Consultant for approval, a quotation being proposed cost for executing change or revision.
- .2 Quotation 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 If overhead and profit percentages are not specified in Division 00 or 01, but allowable under Contract as confirmed with Consultant prior to contract signing, then allowable maximum percentages for overhead and profit are to be 7% and 5% respectively.
- .4 Unless otherwise specified in Divisions 00 or 01, following additional requirements apply to quotations submitted:
 - .1 when change or revision involves deleted work as well as additional work, cost of deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from cost of additional work before overhead and profit percentages are applied to additional work;
 - .2 material costs are not to exceed those published in local estimating price guides;
 - .3 electrical material labour unit costs are to be in accordance with National Electrical Contractors Association Manual of Labor Units at difficult level, less 25%;
 - .4 mechanical material labour unit costs are to be in accordance with Mechanical Contractors Association of America Labor Estimating Manual, 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;

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- .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 change or revision has been obtained from Consultant.

1.20 Progress Payment Breakdown

- .1 Prior to submittal of first progress payment draw, submit a detailed breakdown of work cost to assist Consultant in reviewing and approving progress payment claims.
- .2 Payment breakdown is subject to Consultant's approval and 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 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 they will be indicated on progress draw.

1.21 Notice For Required Field Reviews

- .1 Whenever there is a requirement for Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect work for deficiencies prior to Substantial Performance of the Work, for commissioning demonstrations, and any other such field review, give minimum 5 working days notice in writing to Consultant.
- .2 If Consultant is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until Consultant advises that it may be concealed.
- .4 When Consultant is requested to perform a field review and work is not ready to be reviewed, reimburse Consultant for time and travel expenses.

1.22 Preliminary Testing

- .1 When directed by Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with Specification and governing Codes and Regulations, prior to Substantial Performance of the Work.
- .2 When, in Consultant's opinion, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.

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- .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 to the Contract.

1.23 Provisions For Systems/Equipment Used During Construction

- .1 Any system or piece of equipment that is specified to be provided under requirements of Documents and is required to be used during construction stages of work prior to issuing of Certificate of Substantial Performance of the Work, are to be provided with special interim maintenance and service to cover systems/equipment during time of use during construction period of project until project has been certified as substantially performed and such systems/equipment are turned over to Owner.
- .2 During this period of construction, such systems/equipment to not become property of Owner or be Owner's responsibility for maintenance or service. Systems/equipment are to remain property of respective manufacturers/suppliers or Contractor, who are responsible for full maintenance and servicing of systems/equipment in order to maintain validity of warranties after turn over to Owner.
- .3 Prior to application for a Certificate of Substantial Performance of the Work and turn over to Owner, such systems/equipment to be cleaned, restored to "new" condition, luminaries re-lamped with new lamps, genset serviced, paint finishes touched-up, filters cleaned or replaced, etc.

1.24 Temporary Services

- .1 Coordinate with General Contractor, requirements for temporary services including but not limited to temporary electrical power, lighting and exit pathways. Locations of exit pathways to be as decided at discretion of General Contractor, and to be illuminated complete with emergency lighting, and provided with exit signage and fire alarm devices in accordance with requirements of local governing building code and local governing inspection authorities.

1.25 Cleaning

- .1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of 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 At time of final cleaning, clean luminaire reflectors, lenses, and other luminary surfaces that have been exposed to construction dust and dirt, including top surface, whether it is exposed or in ceiling space.
- .3 Clean switches, receptacles, communications outlets, coverplates, and exposed surfaces.
- .4 Clean other electrical equipment and devices installed as part of this project.

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- .5 For work performed in electrical equipment rooms, electrical closets and communication closets, perform following:
 - .1 HEPA vacuum and clean interiors and buswork of switchboards, panels, cabinets and other electrical equipment of construction debris and dust prior to energization;
 - .2 HEPA vacuum top of switchboards, panels, cabinets, bus ducts, cable trays and conduits in room, followed by a thorough HEPA vacuuming of floors;
 - .3 do not lay permanent switchboard matting in electrical rooms until rooms are re-cleaned, and floors wet mopped and dried just prior to final turn over to Owner.

1.26 Record As-Built Drawings

- .1 Drawings for this project have been prepared on a CAD system using AutoCAD software of release version confirmed with Consultant. For purpose of producing record "as built" drawings, copies of Contract Drawings can be obtained from Consultant.
- .2 As work progresses at site, clearly mark in red in a neat and legible manner on a set of bound white prints of Contract Drawings, changes and deviations from routing of services and locations of equipment shown on Contract Drawings, on a daily basis. Changes and deviations include those made by addenda, change orders, and site instructions. Use notes marked in red as required. Maintain white print red line as-built set at site for exclusive use of recording as-built conditions, keep set up-to-date, and ensure set is available for periodic review. As-built set is also to include following:
 - .1 dimensioned location of inaccessible concealed work;
 - .2 locations of control devices with identification for each;
 - .3 location and identification of devices in concealed locations such as accessible ceiling spaces and raised floors;
 - .4 for underground piping and ducts, record dimensions, invert elevations, offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks to be preserved after construction is complete;
 - .5 location of concealed services terminated for future extension and work concealed within building in inaccessible locations.
 - .6 location of fire alarm devices and include addresses of devices; identify fire alarm zones;
 - .7 identify routing and location of concealed conduits/ducts of diameter 50 mm (2") and greater;
- .3 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of Consultant.
- .4 Use final reviewed "as-built" drawing set to provide CAD files of drawings thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by Consultant as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Consultant.

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- .5 Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with AutoCAD software release version confirmed with Consultant.
- .6 Unless otherwise noted in Divisions 00 or 01, failure to maintain accurate record drawings will incur additional 5% holdback on progress claims until drawings are brought up to date to satisfaction of Consultant.

1.27 Operating & Maintenance Manuals

- .1 Submit draft copy to Consultant for review. Incorporate any Consultant's comments in preparation final manuals.
- .2 For each item of equipment for which a shop drawing is required (except for simple equipment), supply minimum 3, project specific, indexed copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Confirm exact quantity of manuals with Consultant. Consolidate each copy of data in an identified hard cover three "D" ring binder. Each binder to include:
 - .1 front cover: project name label; wording - "Electrical 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 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 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.
 - .7 Performance data is to include:
 - .1 equipment and system start-up data sheets;
 - .2 equipment test reports;
 - .3 final verification and commissioning reports.
 - .8 explanation of operating principles and sequences;
 - .9 inspection certificates issued by regulatory authorities;
 - .10 wiring and connection diagrams;
 - .11 copies of additional and revised panelboard directories;

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- .12 warranties;
- .13 items requested specifically in Section Articles.
- .3 Generally, binders are not to exceed 75 mm (3") thick and not to be more than 2/3 full.
- .4 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.
- .5 Before applying for a Certificate of Substantial Performance of the Work, assemble one copy of O & M Manual and submit to Consultant for review prior to assembling remaining copies. Incorporate Consultant's comments into final submission.
- .6 Provide 2 digital copies of contents of operating and maintenance manuals and load onto separate USB type flash drives and submit to Consultant. Prepare digital copies using version of Adobe Acrobat Portable Document Format or equal as confirmed with Consultant and enhanced with bookmarks and internal document links.

1.28 Commissioning

- .1 Commissioning Agent is appointed by Owner to oversee commissioning activities of contract.
- .2 Interface, cooperate and coordinate with Commissioning Agent and attend commissioning meetings. Perform commissioning activities for aspects of work provided in Electrical Divisions and perform corrective work identified by Commissioning Agent.
- .3 Submit copies of submittals such as O&M manuals, shop drawings, schedules and test reports of systems and equipment to Commissioning Agent, prior to start of commissioning activity or as directed by Commissioning Agent.
- .4 Commissioning Agent may also be present for any testing/commissioning activities. Notify Commissioning Agent in advance of these activities.
- .5 Refer to Division 01 for additional commissioning requirements.

1.29 Project Close Out Submittals

- .1 Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following:
 - .1 Operating and Maintenance Manuals;
 - .2 as-built record drawings and associated data;
 - .3 extended warranties for equipment as specified;
 - .4 operating test certificates;
 - .5 final commissioning 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.

1.30 Instructions To Owner

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.

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- .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 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.
- .4 Before instructing Owner's designated personnel, submit to Consultant for review preliminary copy of training manual and proposed schedule of demonstration and training dates and times. Incorporate Consultant's comments in final copy.
- .5 Obtain in writing from Consultant, list of Owner 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 representative, consultants, etc.).
- .6 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.
- .7 Submit to Consultant copy of electronic version of training materials loaded on USB flash drive. Include in operating and maintenance manuals submission.

1.31 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 maintenance and operating data have been completed and submitted to, reviewed and accepted by Consultant;

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- .4 tags and nameplates are in place and equipment identifications have been completed;
- .5 clean-up is complete;
- .6 spare parts and replacement parts specified have been provided and acknowledged by Consultant;
- .7 as-built and record drawings have been completed and submitted to, reviewed and accepted by Consultant;
- .8 Owner staff has been instructed in operation and maintenance of systems;
- .9 commissioning procedures have been completed;
- .10 fire alarm verification completed and certificate has been submitted.

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PART 1 - GENERAL

1.1 Reference

- .1 Division 00 and Division 01 apply to and are a part of each Electrical Division Section.

1.2 Application

- .1 This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Sections of Electrical Divisions. It is intended as a supplement to each Section of Electrical Divisions and is to be read accordingly.

1.3 Submittals

- .1 Submit shop drawings for products of this Section.
- .2 Additionally as part of shop drawing submission process, submit following to Consultant for review:
 - .1 weight loads of selected equipment (upon request);
 - .2 equipment nameplate and warning sign proposed nomenclature, print type, symbols, sizing and colours;
 - .3 fire stopping installation drawings with ULC certifications;
 - .4 copies of prior to start of construction approvals from local governing authorities having jurisdiction.
- .3 Prior to application for Substantial Performance of the Work, submit following to Consultant for review (note: funds will be withheld until each of following items have been completed and documented to satisfaction of Consultant):
 - .1 fire alarm system testing and verification report of each component of work; devices to be certified working and in proper order;
 - .2 final distribution system testing and documentation to satisfaction of Consultant;
 - .3 structured network cabling system tested and verified to be operating and performing in accordance with specified standards.

1.4 Continuity of Supply for Standardization

- .1 Utilize materials of one manufacturer for aspects of work, where practical. Utilize one common manufacturer for wiring devices, such as switches and receptacles, whether installed loose or in a pre-manufactured component. Coordinate with each supplier and ensure conformance with this requirement. Identify deviations to Consultant and obtain approval of change prior to proceeding with work.

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PART 2 - PRODUCTS

2.1 Conduits

- .1 EMT (Thinwall), galvanized electrical metallic tubing to CSA C22.2 No. 83, complete with factory made bends where site bending is not possible and joints and terminations made with steel couplers and steel set screw type connectors with insulated throats, and concrete tight where required.
- .2 Rigid galvanized steel to CSA C22.2 No. 45, with exterior zinc and interior enamel coatings, galvanized threads where factory cut and red lead coated threads where site cut. Factory made bends where site bending is not possible, factory made and threaded fittings, and connectors, and terminations with rigid couplings, and concrete tight where required.
- .3 Galvanized steel flexible liquid tight metallic conduit to CSA C22.2 No. 56, complete with Ideal "Steel Tough" liquid-tight flexible conduit connectors at terminations.
- .4 Galvanized steel flexible metallic conduit to CSA C22.2 No. 56, complete with proper and suitable squeeze type connectors at terminations.
- .5 CSA approved and labelled, FT-4 rated, rigid plastic (PVC) conduit complete with site made heat gun bends on conduit to 50 mm (2") diameter, factory made elbows in conduit larger than 50 mm (2") diameter, solvent weld joints, factory made expansion joints where required, and terminations made with proper and suitable connectors and adaptors.

2.2 Outlet Boxes

- .1 CSA approved stamped galvanized steel outlet boxes.
- .2 Crouse-Hinds Canada Ltd., CSA certified, "FS" or "FD" Series cast Feraloy and aluminium outlet boxes.
- .3 CSA certified rigid plastic (PVC) outlet boxes.
- .4 Each outlet box and back box to be suitable in respects for application and complete with suitable securing lugs, connectors suitable for connected conduit, knockouts and, where necessary, suitable plaster rings, concrete rings, covers, carpet flanges and any other required accessory.
- .5 Electrical boxes exposed exterior of building or in non-climate controlled locations to be weatherproof boxes complete with gasketed covers/faceplates.

2.3 Pull Boxes & Junction Boxes

- .1 Galvanized or prime coat plated steel, suitable in respects for application and complete with screw-on or hinged covers as required, and connectors suitable for connected conduit.
- .2 Cooper Crouse-Hinds, "Condulet", threaded cast Feraloy outlet boxes of an exact type to suit application, each complete with screw-on gasketed cover.
- .3 Rigid plastic (PVC), CSA certified, junction boxes and access fittings with solvent weld type joints and screw-on PVC covers.
- .4 Physical size of pull boxes to be as required by local governing electrical code to suit number and size of conduits and conductors.

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- .5 Each box to be suitable in respects for application and complete with suitable securing lugs, connectors suitable for connected conduit, knockouts and, where necessary, suitable plaster rings, concrete rings, covers and any other required accessory.
- .6 Boxes exposed exterior of building or in non-climate controlled locations to be weatherproof boxes complete with gasketed covers.

2.4 Sleeves

- .1 Galvanized steel sleeves as follows:
 - .1 No. 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.

2.5 Firestopping & Smoke Seal Materials

- .1 Asbestos-free, elastomeric materials and intumescent materials, tested, listed and labelled by ULC in accordance with CAN 4-S115-M85, and CAN/ULC-S101-M 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.
- .2 Fire stopping and smoke seal material system to be specifically ULC certified with designated reference number for its specific installation. As part of shop drawing submission, submit copies of firestopping drawings with ULC certificate and number for each specific installation. Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- .3 Systems to consist of both elastomeric and intumescent materials that are compatible with abutting dissimilar materials and finishes. Coordinate material requirements with trades supplying abutting areas of materials.
- .4 Typically, for openings of up to 250 mm (10") in diameter, provide putty pad type firestop materials equivalent to Specified Technologies Inc. "SpecSeal" intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibres or silicone compounds.
- .5 Typically, for openings of greater than 250 mm (10") in diameter, and for rectangular openings, provide pillow type firestop materials equivalent to Specified Technologies Inc. "SpecSeal" re-enterable, non-curing, mineral fibre core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag.
- .6 Supply products of a single manufacturer for use on work of this Division.
- .7 Installer to be manufacturer trained and certified on specific product. Submit copy of certificate with shop drawings.
- .8 Include for manufacturer authorized representative to inspect and verify each installation and application. Submit test report signed and verified by system installer's authorized representative and manufacturer representative.

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- .9 Acceptable certification to also include certification by Underwriters Laboratories of Northbrook IL, using tests conforming to ULC-S115 and given cUL listing published by UL in their "Products Certified for Canada (cUL) Directory".
- .10 Acceptable manufacturers are:
 - .1 Specified Technologies Inc.;
 - .2 3M Canada Inc.;
 - .3 Tremco;
 - .4 A/D Fire Protection Systems;
 - .5 Nelson;
 - .6 Hilti Canada.

2.6 Fastening & Securing Hardware

- .1 Concrete inserts - Crane Canada Ltd., No. 4-M for concrete work for single or double conduit, cable tray, etc., runs and equipment. Unistrut Ltd. multiple type inserts for runs of three (3) or more conduits etc., or where a grid support system is required.
- .2 Concrete fasteners - "WEJ-IT" anchors, lead cinch anchors and/or "STAR" or "PHILLIPS" self-drilling anchors.
- .3 Masonry inserts - "WEJ-IT" expansion shields and machine bolts or, for light loads, fibre or lead plugs and screws.
- .4 Drywall or plaster wall and/or ceiling fasteners - 2-wing spring toggles.
- .5 Structural steel - Crane Canada Ltd., beam clamps.
- .6 Metal framing channels - 40 mm (1-5/8") width, galvanized steel channels complete with required fittings and ancillary hardware; acceptable manufacturers are:
 - .1 Unistrut;
 - .2 Thomas & Betts;
 - .3 Eaton B-Line.
- .7 Metal "J" hooks or Panduit "J-Pro" cable support systems for communications system cabling in accessible ceiling spaces where conduit or cable tray is not being provided. Obtain written approval of Consultant for use of J-hooks.
- .8 Velcro tie wraps for bundling and securing cables.

2.7 Access Doors

- .1 Access doors to be provided under work of Division 08 by General Trades Contractor.
- .2 Coordinate with Mechanical Contractor and General Trades Contractor to ensure that access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and that work involving both mechanical and electrical services to where possible be accessible from common access door. Coordinate work to ensure that same common location access doors are not supplied by more than one Division.

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- .3 Size access door to suit concealed work for which they are supplied and wherever possible they are to be of standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.
- .4 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.
- .5 Identify on reflected ceiling plans and wall elevation drawings, coordinated locations of proposed access door locations and submit to Consultant for review.

2.8 Identification Nameplates

- .1 Laminated plastic (Lamacoid) black-white-black with bevelled edges, stainless steel screws, and proper identification engraving. Each nameplate to be sized to suit equipment for which it is provided, and required wording. Confirm nomenclature with Consultant. Various colour configurations to be used to differentiate systems. Confirm exact colour scheme with Consultant and/or Owner.
- .2 Brother "P-Touch", portable electronic labelling system complete with self-adhesive, permanent printed labels with required nomenclature.

2.9 System Backboards

- .1 FSC (Forest Stewardship Council), G1S (good one side) construction grade fir plywood, containing no added urea formaldehyde, flame retardant prime coat painted on exposed surfaces, minimum 20 mm (3/4") thick, as sized on drawings and with flame spread rating in accordance with local governing building code requirements.

2.10 Sprinkler Protection

- .1 Provide drip shields for protection of surface mounted equipment enclosures from water spray and dripping of liquids. Features of shields include:
 - .1 factory constructed by respective equipment manufacturers;
 - .2 constructed from non-combustible materials (sheet steel);
 - .3 enamel painted to match equipment;
 - .4 surfaces and edges filled/sanded smooth prior to painting;
 - .5 supported from equipment with structural steel rods/metal framing or other method approved by Consultant;
 - .6 structural support finish painted to match shield.
- .2 Include with equipment shop drawings, detailed dimensions of drip shields and methods of supporting.
- .3 Equipment with top cable/conduit entries to include additional sealing of entries with gasketting and/or waterproof sealant to prevent water from entering enclosure.
- .4 Design ventilation louvers such that live components are not exposed to water spray and dripping liquids.
- .5 Above requirements are additional minimum "sprinkler protection" standards for equipment specified as EEMAC/NEMA 1, 2 or 12.
- .6 Obtain CSA approval where required by local governing authorities.

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2.11 Rooftop Conduit Support System

- .1 Cooper B-Line "Dura - Blok" series rooftop support systems with features as follows:
 - .1 CSA approved and/or ULC listed and labelled;
 - .2 non-penetrating of roof;
 - .3 vibration dampening;
 - .4 does not float;
 - .5 suitable for outdoor wet and freezing environments without damage caused by weather or freeze and thawing when exposed to de-icing chemicals;
 - .6 environmental friendly;
 - .7 constructed of recycled rubber.
- .2 Materials:
 - .1 Dura-Blok Curb base made of 100% recycled rubber and polyurethane pre-polymer with a uniform load capacity to suit specific load application of support (minimum 744 kg/m [500 pounds/linear foot]); each base to have a reflective red stripe.
 - .2 DB Series base: Dimensions: 150 mm (6") wide by 125 mm (5") tall by required overall length (minimum 225 mm [9"]); this is to be minimum dimensions, but base requirements must be increased to suit specific applications as recommended by system manufacturer; includes low base steel frame C channel 1.9 mm (14 gauge) - 25 mm (1") high strut galvanized per ASTM A653; and pipe roller assembly.
 - .3 Attaching hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633.
 - .4 Conduit clamps: single pipe supports constructed of galvanized steel and sized to accommodate sizing of installed conduits.
- .3 Confirm with system manufacturer that selected products provide proper support for application.
- .4 Acceptable manufacturers are as follows:
 - .1 Cooper B-Line;
 - .2 Clearline Technologies (C-Port);
 - .3 Erico (Caddy Pyramid).

PART 3 - EXECUTION

3.1 General Conduit Installation Requirements

- .1 Install conduit concealed in finished areas, and concealed to degree made possible by finishes in partially finished and unfinished areas. Conduit may be exposed in unfinished areas such as Electrical and Mechanical Rooms, unless otherwise noted on drawings or specified herein. Refer to and examine architectural drawings and room finish schedules to determine finished, partially finished or unfinished areas of building. Documents do not identify exact routing. Where shown, routing is diagrammatic, identifying general requirements of routing and locations. Include for necessary offsets, fittings, transformations and similar items required as a result of obstructions and other architectural or structural details not shown.

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- .2 Where conduits are exposed, arrange them to avoid interference with other work, parallel to building lines and install as high as possible. Do not install conduits within 150 mm (6") of "hot" pipes or equipment unless conduits are associated with equipment. Independently run conduit to be supported from wall/ceiling structure, not from ceiling hangers, ductwork, piping, cable trays, formed steel decking, etc. Do not run conduits within 900 mm (3') of equipment access opening covers.
- .3 So as not to impair required strength of structure, following criteria to be generally followed but which is to be reviewed and coordinated with Consultant prior to start of Work:
 - .1 where conduits pass by a column, stay at least two times thickness of slab and drop away from column;
 - .2 where conduits terminate adjacent to a column or wall, bring conduit in toward column/wall as close to 90° to face of column as possible within two times thickness of slab and drop away from column;
 - .3 maximum size of conduit in structural slabs is 1/5 of solid portion of slab thickness;
 - .4 where more than two conduits are adjacent to each other, they are to be spaced greater of 3 diameters or 100 mm (4") apart;
 - .5 total of depth of conduits crossing over each other is to be less than one-third thickness of slab;
 - .6 place conduit in middle third of thickness of slab; do not lay conduit directly on reinforcing steel;
 - .7 do not run conduit adjacent to parallel reinforcing bars;
 - .8 do not run conduit longitudinally in beam without approval of Owner and review with Consultant; pass through beams at right angles to span of beam;
 - .9 where conduits pass through beams, maintain at least twice depth of beam separation away from supports;
 - .10 do not run conduits in slab beside a drop or beam within twice depth of slab from edge of drop or beam;
 - .11 do not run conduits through shear walls or columns without approval of Owner and review with Consultant;
 - .12 do not place conduit in structural elements in parking garage structures, water retaining structures or structures subjected to de-icing chemicals, without approval of Owner and review with Consultant.
- .4 For proposed use of conduit runs underground below slab include following provisions:
 - .1 concrete encased ductbank with conduits of non-ferrous materials and sloped to drain properly into pit;
 - .2 proper drain pit;
 - .3 system to be a pull-in system;
 - .4 20% spare conduits (with minimum of at least 1);
 - .5 system proposal to consider and address any effects of magnetic fields.
- .5 Conduits are sized on drawings, but in absence of type and sizing, type and size to suit intended application in accordance with applicable local governing electrical code requirements. Sizes identified on drawings are minimum sizes and are not to be decreased unless approved by Owner and reviewed with Consultant.

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- .6 Where receptacle type devices are located in existing floors and/or where feeds are required to furniture systems in open spaces, and where chasing of floor slab to run conduit is not acceptable to Owner after review with Consultant provide fire rated "poke-thru" assembly installed through floor and feed from conduit runs provided in ceiling space of floor below.

3.2 Installation of Conduit

- .1 Provide conduit for conductors except armoured cable and copper sheathed mineral insulated conductors, and except where duct or similar raceway materials are provided.
- .2 Provide conduit as follows:
 - .1 for interior building surface mounted services greater than 600 V - rigid galvanized steel;
 - .2 for feeders exceeding 600 V for main distribution wiring in Electrical rooms, and for concealed conduit in exterior walls-rigid galvanized steel;
 - .3 for exposed conduit outside building, for semi-exterior areas such as loading areas and within parking garage floor areas - rigid galvanized steel (rigid PVC where permitted by local codes and Owner and reviewed with Consultant);
 - .4 for branch circuit conductors underground inside building, and underground outside building beneath concrete, asphalt, and similar paving material-rigid PVC;
 - .5 for exposed conduit mounted at a height of less than 1200 mm (4') in electrical, mechanical or other service areas - rigid galvanized steel;
 - .6 for short branch circuit connectors to motorized equipment and distribution transformers (minimum length 450 mm (18"), maximum length 600 mm (24") with 180° loop where possible) - galvanized steel flexible liquid-tight conduit;
 - .7 at points, where conductors cross building expansion joints - galvanized steel flexible conduit with no less than 600 mm (24") of extra curve;
 - .8 for branch circuit conductors in poured concrete slab - rigid PVC;
 - .9 for interior conduit above 50 mm (2") diameter containing distribution conductors or communication systems conductors (fire alarm, telephone etc.) (except as noted above) - EMT with separate insulated ground conductor;
 - .10 for conductors except as noted above or elsewhere in this Specification - EMT.
- .3 Run rigid conductors in rigid type conduits suitable for application. Do not use flexible conduit.
- .4 Secure conduit located in poured concrete work in place in a manner such that conduit will not float or move when concrete is poured. Adequately protect such conduit from damage prior to and during concrete pour, and from concrete and water penetration.
- .5 Review with Consultant prior to Start of Work, maximum allowable size of conduit for installation in poured concrete. Placement of reinforcing steel in structural concrete work will take precedence over placement of conduit. Spaced adequately multiple runs of conduit in poured concrete work, as reviewed with Consultant.
- .6 Install flexible polyethylene conduit in continuous lengths wherever possible and "snake" conduit in trench. Where joints are necessary, make same with nylon inserts and stainless steel gear type clamps. Terminate with rigid conduit threadless connectors. Grade bed to provide proper drainage of conduits.

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- .7 Support underground conduit on a well-tamped flat bed of earth, free from rocks or protrusions of any kind. Grade and slope bed to provide conduits and ducts with proper drainage. Coordinate with General Trades Contractor for provision of means to carry away drainage water. Obtain required approvals of work from local governing electrical utility and review with Consultant prior to back filling and covering. Provide pull cord in each duct run.
- .8 Provide manufactured expansion joints in rigid PVC plastic conduit at spacing as recommended by conduit manufacturer.
- .9 Provide a separate ground conductor in plastic conduits.
- .10 Support and secure surface mounted and suspended single or double runs of metal conduit at support spacing in accordance with local governing electrical code requirements by means of galvanized pipe straps, conduit clips, ringbolt type hangers, or by other proper manufactured devices.
- .11 Support multiple mixed size metal conduit runs with Unistrut Ltd., Electrovert Ltd. "CANTRUSS" or Burndy Ltd. "FLEXIBLE" conduit racks spaced to suit spacing requirements of smallest conduit in group.
- .12 Unless otherwise noted, provide conduit fittings constructed of same materials as conduit and which are suitable in respects for application.
- .13 Provide proper adaptors for joining conduits of different materials.
- .14 Cut square and properly ream site cut conduit ends.
- .15 Provide conduit as sized on drawings. Size conduit not sized on drawings in accordance with latest edition of local governing electrical code with consideration that sizes of branch circuit conductors indicated are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with voltage drop schedule found on drawings or at end of this section. Where conductor sizes are increased to suit voltage drop requirements, increase scheduled or specified conduit size to suit. Unless otherwise noted on drawings or required by local governing electrical code or specified elsewhere, conduit to be of minimum size 13 mm (1/2") diameter. Structured network cabling system conduit to be of minimum 19 mm (3/4") diameter, unless otherwise noted.
- .16 Site made bends for conduit to maintain full conduit diameter with no kinking, and conduit finishes are not flake or crack when conduit is bent.
- .17 Plug ends of roughed-in conduits which are exposed during construction with approved plugs.
- .18 Ensure that conduit systems which are left empty for future wiring are clean, clear, capped and properly identified at each termination point. Provide end bushing and suitable fish wires in such conduits.
- .19 Provide empty conduits to ceiling spaces from flush mounted panelboards located below and/or near hung ceiling. Refer to drawing detail.
- .20 Conduits shall be colour coded and with paint located at junction boxes and every 5 feet along each run as follows:
 - .1 Yellow - Line voltage
 - .2 Red - Fire Alarm
 - .3 Blue - Low voltage emergency lighting

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- .4 Purple - Security intrusion
- .5 Orange - Building automation
- .6 Green - Network cabling

3.3 Expansion Facilities for Conduit Crossing Building Expansion Joints

- .1 Wherever concealed or surface mounted conduits cross building expansion joints, provide expansion facilities to permit free movement without imposing additional stress or loading upon support system, and to prevent excessive movement at joints and connections, in accordance with drawing details.

3.4 Installation of Outlet Boxes & Back Boxes

- .1 Provide an outlet box or back box for each luminaire, wiring device, telephone outlet, fire alarm system component, communications systems components, and each other such outlet.
- .2 Size boxes to accommodate exact supplied components and for bending radii of installed cables. Confirm requirements with respective system vendors.
- .3 Outlet boxes flush mounted in interior construction, surface mounted in concealed interior locations, and surface mounted in exposed interior locations where connecting conduit is EMT, to be stamped and galvanized steel outlet boxes unless otherwise noted.
- .4 Provide sealing around boxes in walls where insulation and vapour barrier is present or for walls of rooms that are sealed. Maintain sealing system of wall.
- .5 Outlet boxes in underground plastic conduit systems to be rigid PVC plastic outlet boxes, unless otherwise noted.
- .6 Outlet boxes for flush floor mounted devices to be concrete tight formed galvanized steel fully adjustable flush floor boxes. Locate in to position and install in accordance with manufacturer instructions. Coordinate installation with trades pouring concrete floor slab or trade responsible for floor construction.
- .7 Provide outlet boxes for special wiring devices, for special equipment and special applications. Refer to requirements specified in other Sections and/or on drawings.
- .8 Size and arrangement of outlet boxes to suit device which they serve.
- .9 Mounting heights and locations for outlet boxes are typically indicated on drawings, however confirm exact location and arrangement of outlets prior to roughing-in. Architectural drawings and Consultant's instructions have precedence over electrical drawing diagrammatic layouts and specified mounting heights and locations.
- .10 Do not install outlet or back boxes "back-to-back" in walls and partitions. Stagger such outlets and seal against noise transmission in accordance with drawing details. "Thru-wall" type boxes will not be permitted for any application.

3.5 Mounting Heights

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

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- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1100 mm.
 - .2 Wall receptacles:
 - .1 General: 400 mm. In block, 400 mm to underside
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 200 mm.
 - .4 In mechanical rooms: 1200 mm. In block. 1200 mm to top side
 - .3 Panelboards: 1800 mm or as indicated.
 - .4 Telephone and Interphone outlets: at height of adjacent outlet of 400 mm. In Block, 200 mm to underside.
 - .5 Wall mounted telephone and interphone outlets: 1500 mm.
 - .6 Fire alarm stations: 1200 mm.
 - .7 Fire alarm bells: 2250 mm
 - .8 Television outlets: 400 mm. In block 400 mm to underside
 - .9 Wall mounted speakers: 2250 mm.
 - .10 Emergency call switches and/or pushbuttons: 900 mm

3.6 Installation of Pull Boxes & Junction Boxes

- .1 Provide pull boxes in conduit systems wherever shown on drawings, and/or wherever necessary to facilitate conductor installations. Generally, conduit runs exceeding 30 m (100") in length, or with more than two - 90° bends, are to be equipped with a pull box installed at a convenient and suitable intermediate accessible location.
- .2 Size boxes to accommodate exact supplied system and for bending radii of installed cables. Confirm requirements with respective system vendors.
- .3 Provide junction boxes wherever required and/or indicated on drawings and as required by local governing electrical code.
- .4 Provide sealing around boxes in walls where insulation and vapour barrier is present or for walls of rooms that are sealed. Maintain sealing system of wall.
- .5 Boxes in rigid conduit and EMT inside building to be stamped galvanized or prime coated steel.
- .6 Boxes in exterior rigid conduit and boxes in perimeter wall where insulation and vapour barrier is present, to be "Condulet" cast gasketed boxes, unless otherwise noted.
- .7 Boxes in plastic conduit to be rigid PVC plastic boxes complete with required couplings.
- .8 Pull boxes and junction boxes to be accessible after work is completed.
- .9 Accurately locate and identify concealed pull boxes and junction boxes on "As-built" record drawings.
- .10 Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting outside of covers. Spray painting is not permitted unless approved by Owner and reviewed with Consultant. Paint colours to be in accordance with following schedule:
 - .1 Yellow - Line Voltage
 - .2 Red - Fire Alarm

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- .3 Blue - Low voltage emergency lighting
- .4 Purple - Security intrusion
- .11 In addition to painting miscellaneous signal boxes, clearly identify specific system in which box is installed.
- .12 Cover boxes in fire walls with aluminium tape and seal with caulking.

3.7 Installation of Sleeves

- .1 Where conduits, round ducts 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 No. 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") above floor.
- .4 Sleeves in poured concrete walls and foundation are to be Schedule 40 pipe.
- .5 Size sleeves, unless otherwise noted, to leave 13 mm (1/2") 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 titled "Firestopping and Smoke Seal Materials" specified here in this Section. Ensure that sleeves set in exterior walls are packed and sealed with governing authority approved materials suitable for application and that both ends of sleeves are packed watertight with approved permanently flexible and water tight materials. Exact responsibility of work to be coordinated with General Trades Contractor.
- .6 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.
- .7 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.
- .8 "Gang" type sleeving to be permitted only with approval of Owner and reviewed with Consultant.
- .9 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.

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3.8 Installation of Firestopping & Smoke Seal Materials

- .1 Where electrical work penetrates or punctures fire rated construction, provide ULC certified, listed and labelled firestopping and smoke sealing packing material systems to seal openings and voids around and within raceway and to ensure that continuity and integrity of fire separation is maintained. Submit to Consultant, copies of certificates of compliance from an independent testing agency, attesting that fire stopping and smoke seal materials meet ULC requirements. Openings not in immediate vicinity of working areas are to be firestopped and sealed same day as being opened.
- .2 Examine condition of voids to be filled to ensure suitability for systems. Verify installation of service penetrations and adjacent construction has been completed. Prepare substrates and surfaces to a clean, dry, frost-free condition, and primed to firestop system manufacturer recommendations to receive firestopping system.
- .3 Install fire stopping and smoke seal materials for each installation in strict accordance with specific ULC certification number and manufacturer instructions. Comply with local governing building code requirements and obtain approvals from local building inspection department. Ensure that openings through fire separations do not exceed maximum size wall opening, and maximum and minimum dimensions indicated in ULC Guide No. 40 U19 for Service Penetration Assemblies and fire stopping materials.
- .4 Ensure that continuity and integrity of fire separation is maintained and conform to requirements of latest edition of ULC publication "List of Equipment and Materials, Volume II, Building Construction".
- .5 After installation work is complete, arrange for manufacturer authorized representative to inspect and verify each installation and provide a test report signed by installing trade and manufacturer representative. Test report to list each installation and respective ULC certification and number.

3.9 Installation of Fastening & Securing Hardware

- .1 Provide fasteners and similar hardware required for conduit, duct, raceway, conductors, etc. and for equipment hanger and/or support material unless otherwise noted.
- .2 Accurately and properly set concrete inserts in concrete framework. Where multiple type inserts are used, space same to suit requirements of smallest conduit, etc., in group.
- .3 Fasten hanger and support provisions to masonry with expansion shields and machine bolts, or, for light loads, use plugs, and screws.
- .4 In drywall or plaster walls and/or ceilings use two wing toggles and for heavy loads, provide steel anchor plates with two or more toggles to spread load.
- .5 Provide beam clamps for attaching hanging and/or support provisions to structural steel, or where approved by Owner and reviewed with Consultant, weld hanging and support provisions to structural steel.
- .6 Explosive powder actuated fasteners are not permitted unless specific written approval for their use and type has been obtained from Consultant.
- .7 Under no circumstances use ceiling suspension hangers or grids for suspension of conduit and conductors. Install supports to permanent structure of building, limited to areas that will not damage structural stability.

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- .8 Provide "J" hooks in accessible ceiling spaces where conduit is not provided for structured cabling runs or other telecommunication cabling, as approved by Consultant.
- .9 Comply with J-hook manufacturer loading limitations and spacing criteria. Do not exceed 1.2 m (4') spacing interval. Add additional J-hooks if cabling sags, at discretion of Consultant. Drill anchors for J-hooks into slab not into post tensioned beams. Do not install more than one system on each J-hook.
- .10 Install Velcro tie wraps on bundled telecommunication cables and do not over tighten. Provide FT6/CMP rated wraps in plenum type spaces as per local building code requirements.
- .11 Comply with Structural Engineer's limitations for maximum penetrations of securing hardware into concrete slabs.

3.10 Installation of Identification Nameplates

- .1 For each piece of electrical distribution equipment from electrical source of supply up to and including panelboards, for special control panels and cabinets, and for each other piece of electrical equipment, provide engraved Lamacoid identification nameplates secured to apparatus with stainless steel screws. Nameplates to indicate source of electrical supply and include Consultant's equipment identification number. Identify whether equipment is on "NORMAL POWER SYSTEM" or "ESSENTIAL POWER SYSTEM". Comply with CSA Z32 requirements.
- .2 Equip large multiple cell or component apparatus such as switchboards and distribution panels with main nameplates identifying equipment, voltage characteristics, capacity and source of supply, and with sub-nameplates clearly identifying each cell or component and its service.
- .3 Panelboard nameplates to identify panelboard number as designated on drawings, unless otherwise instructed. Nameplates for disconnect switches, control panels, and cabinets to outline their service and source of supply.
- .4 In areas where equipment having removable doors that can be commonly installed on different equipment, ensure that each door is identified to which piece of equipment it is associated with, such that nameplates are with correct equipment.
- .5 Panelboard identification is to be arranged as follows: "FLOOR-C-A" where:
 - .1 "FLOOR" denotes floor of building;
 - .2 "C" denotes load type served;
 - .3 "A" denotes panelboard number;
- .6 Nameplates to be mechanically secured lamacoid and be colour coded as follows:
 - .1 Normal Power careBlack with white letters;
- .7 Above identification nameplate and nomenclature requirements are for typical requirements for pricing only.
- .8 In pull boxes, junction boxes and at terminations, identify feeders by use of plastic plates indicating system voltage and circuit designations. Plates to be 25 mm (1") in diameter and have letter stamped 9 mm (5/8") high. Colour coding to be:
 - .1 Phase A - red;
 - .2 Phase B - black;

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- .3 Phase C - blue;
- .4 Neutral - white;
- .5 Ground - green.
- .9 Confirm print size type and size, colours, sizing and nomenclature of nameplates with Consultant prior to ordering. Submit sample board.

3.11 Installation of Terminal Backboards

- .1 Provide specified terminal backboards for communication systems and electrical distribution equipment.
- .2 Securely wall mount each backboard with proper fasteners to suit wall construction.
- .3 Unless otherwise noted, size backboards to sufficiently provide adequate terminal space for each system, plus 20% space for future additions.

3.12 Installation of Rooftop Support System

- .1 Install rooftop support system for conduits/raceways in accordance with manufacturer instructions and recommendations to suit type of raceway and roofing materials.
- .2 If gravel top roof, remove gravel from around and under pipe support. Coordinate work with building roofing vendor confirmed with Owner and reviewed with Consultant.
- .3 Consult existing roofing vendor for roof membrane compression capacities and roof loading limitations. Comply with restrictions.
- .4 Use properly sized clamps to suit conduit sizes. Ensure that installation and use of system does not invalidate existing roof warranties.
- .5 Engage existing roofing vendor to inspect installation and verify that installation has not damaged roof.

3.13 Branch Circuit Balancing

- .1 Connect branch lighting and power circuits to panelboards so as to balance actual loads (wattage) within 5%. If required, transpose branch circuits when work is complete to meet this requirement.
- .2 At request of Consultant, perform necessary tests to show compliance with above requirement. Make such tests after building is occupied.

3.14 Disconnection, Removal & Relocation Work

- .1 Where indicated on drawings or where required to perform Work of this Project, disconnect and remove items of existing obsolete electrical work. Relocate required devices as required to accommodate work of other Divisions. Where luminaires, switches, receptacles, and other devices and/or equipment is removed, disconnect at point of electrical supply, remove obsolete wiring and conduit up to source, unless otherwise noted, and make system safe to Owner satisfaction and as reviewed with Consultant. Remove obsolete conduit/raceways in accessible ceiling spaces, exposed locations, etc. Where existing obsolete conduit and similar raceway material cannot be removed, such as embedded in concrete, cut back and cap obsolete conduit and raceways. Refer to specific notes on drawings.

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- .2 When respective work is deleted, such deletions are to in no way affect operation of any existing interconnected mechanical or electrical components that remain. When existing circuits are being disconnected, maintain supervision of area to ensure that such circuits do not affect essential existing circuits being retained.
- .3 Refer to architectural drawings which define extent of areas being demolished in existing building. Review drawings and site and include for demolition and/or renovation of services as required to accommodate alterations detailed.
- .4 Unless otherwise noted, obsolete materials which are removed and are not to be relocated or reused are to become your property. Remove from site and properly dispose. Obtain from Owner and coordinate with Consultant, a list of existing electrical items which are to be removed and turned over to Owner. Said items are to remain property of Owner.
- .5 Where existing services pass through or are in an area to serve items which are to remain, or pass through areas that are to be deleted, maintain services, but re-route as required. 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. Confirm with Owner services which are to be kept in service and operational.
- .6 Revise panelboard directories accordingly, if affected by any renovation, disconnection, or removal of work. Use Owner's actual room names/numbers.
- .7 Protect existing devices being relocated or deleted to ensure that they are not damaged. Test such devices prior to disconnection and de-energization, to ensure that each device is in proper working condition. Ensure that motors are in proper rotation direction. Examine each device for damage. Report devices not working or with damage to Consultant prior to initiating any work. It will be assumed that devices are in proper working order and good condition if not reported.
- .8 Provide junction boxes, outlet boxes, wiring, plates, etc., as necessary for complete relocation of devices. Clean relocated or temporary removed devices and equipment, and ensure that they are in good operating condition before being reinstalled. Where existing luminaires are relocated, clean luminaires and inspect for damage. Re-lamp relocated luminaires. Report defects or damages to Consultant. Do not splice conductors unless approved by Owner and reviewed with Consultant. Utilize junction boxes and terminal devices for proper extension of circuits where approved. Otherwise replace circuits with home run continuous run of suitable lengths.
- .9 Provide blank coverplates on existing obsolete boxes which are to remain in position.
- .10 After installation is complete, test parts of re-used or relocated electrical equipment and correct faults and grounds. Include for fire alarm verification company to verify any relocated devices and downstream affected devices, and verify system as required by local fire authority to suit actual relocation work. For other existing systems, engage manufacturers authorized representative or Owner's system maintenance contractor, to inspect and verify relocated devices. Coordinate and confirm exact requirements with Owner and/or Consultant. Document testing in test reports, signed by testing technician. Submit copies to Consultant.

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- .11 Interior, exterior or underground electrical services (including auxiliary services, telephone, fire alarm, P.A. System, etc.) to operating parts of building are not to be hampered under any conditions and to that effect, necessary work may have to be carried out on an overtime basis, at no additional cost to this project. Existing risers are to be maintained in service as required to feed other areas of building(s). Do not interrupt any services without prior written approval by Owner and reviewed with Consultant. Submit formal requests to Consultant outlining in detail requirements of proposal and wait for instructions from Consultant.
- .12 Be present when new doors or openings are being cut into existing walls and ceilings. Should any damage occur to electrical system, restore system to a safe and sound condition.
- .13 Where references are made on drawings that existing receptacles, etc., be extended and/or relocated to suit new construction, receptacles, etc., are to be tested and if found defective, be replaced with new devices. Cracked or broken cover plates are to be replaced and match Architectural finishes. Contractor may optionally replace existing basic receptacles, switches, and faceplates with devices matching existing devices.
- .14 Be responsible for disconnecting power supply to branch circuits controlling lighting, receptacles, panels, mechanical equipment, etc., for safe removal of equipment, conduit, wiring, boxes, etc., affected by demolition.
- .15 Close openings in boxes, panels, etc., that result from removal of equipment, conduit, wiring, fixtures, etc. Close openings in a proper manner and properly terminate and insulate cables to restore system to a safe operating condition, to Consultant's satisfaction.
- .16 Be present and supervise removal of electrical equipment, P.A. speakers, etc., during demolition of ceilings, walls, floors, etc. Existing equipment which is not to be relocated but interferes with demolition, are to be temporarily relocated until demolition work is completed. Services to temporarily relocated equipment are to be maintained at all times.
- .17 Remove and re-install existing ceiling tiles as required to perform work. Prior to removal, inspect tiles for damage and report any to Owner and Consultant. Any loose cabling is to be secured, and luminaires additionally supported with cables secured to ceiling slab. After work has been completed and successfully inspected, re-install ceiling tiles to existing standards and re-install devices. Be responsible for replacement of tiles and grid members damaged during work of Electrical Division. Comply with applicable governing authority requirements with regards to ceiling work in special areas.
- .18 Where existing surfaces are damaged by Electrical Divisions work and/or where existing devices are removed from wall, ceilings, floors and other surfaces, and such deleted devices are not being replaced in same locations, patch locations of these removed devices and re-finish. Patching and finishing is to be provided by tradesmen skilled in particular trade or application worked on, to Consultant's approval. Where openings are left in existing ceiling tiles, replace ceiling tiles with new matching tiles approved by Consultant. Unless otherwise included for in other Divisions, include for:
 - .1 preparing existing surfaces to be filled and repainted to be cleaned as required to remove dirt, dust, oil, grease, loose paint, rust and any other foreign matter which would prevent proper bonding of new finish; sand glossy surfaces to uniform dull texture;

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- .2 filling in and patching surfaces with same material as existing surfaces; finished surfaces to match and line with existing adjoining surfaces;
- .3 providing fire stopping materials to maintain fire rating of the existing surfaces; refer to specification article titled - Firestopping and Smoke Seal Materials.
- .4 using paint rollers and/or brushes to apply and extend paint finish over full height and/or width of area affected, to a straight line in location determined by Consultant;
- .5 applying sufficient number of coats such that patched area is indistinguishable to surrounding area;
- .6 materials used to be of equivalent quality to existing finishes standards and be compatible with finishes to which they are applied;
- .7 finishes to be approved by Owner and reviewed with Consultant.
- .19 Check luminaires to be deleted for PCB ballasts. Disconnect and remove such ballasts. As specified previously, include for company specialized in such hazardous materials to remove and dispose such materials off-site in compliance with Ministry of Environment, Ministry of Transport and any other governing authority regulations.
- .20 If at any time during course of building work, asbestos containing materials are encountered or suspected, cease work in area in question and immediately notify Consultant. Comply with local governing authority regulations. Do not resume work in affected area without approval from Consultant.

3.15 Interruptions to & Shut-Downs of Services & Systems

- .1 Shutdowns and interruptions to existing systems and services are to be coordinated fully with and performed at times acceptable to Owner and reviewed with Consultant. Generally, shutdown may be performed only between hours of 12:00 midnight Sunday until 6:00 a.m. Monday morning. 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 contract, submit to Consultant for review and approval, a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform Consultant and Owner 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 written consent. Note that shutdowns of some essential services may require additional advance notification time.
- .4 Work associated with shut-downs and interruptions are to be carried out as continuous operations to minimize shut-down time and to reinstate systems as soon as possible. Prior to any shut-down, ensure that materials and labour required to complete work for which shut-down is required are available at site.
- .5 Confirm with Consultant if any feeder is designated for special considerations and if designated as such and is to be interrupted, ensure that at least following preparations are met:
 - .1 provide a schedule of proposed feeders to be interrupted; propose one feeder at a time to be worked on per scheduled shutdown;
 - .2 provide a method of procedure for work;

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- .3 prepare above documentation and submit for review by Consultant at least fifteen working days prior to date of each proposed work;
 - .4 on day/night of proposed feeder work, advise Consultant of which feeder is to be worked on; confirm with Consultant requirements for witnessing work;
 - .5 de-energize feeders and perform work as per Consultant and Owner reviewed schedule;
 - .6 after feeders are re-routed, megger test each feeder.
- .6 Where working in close proximity to "live parts" or inside energized panels or energized cubicles of switchboards/substations, provide protection "boots" over bussing and insulating mats to cover areas of exposed live parts.

3.16 Equipment Bases & Supports

- .1 Provide equipment bases and supports. Coordinate concrete pour for housekeeping pads and luminaire poles bases with Division 03. Ensure that applicable seismic restraint provisions are provided as per local governing building code.
- .2 Secure floor mounted equipment in place on minimum 100 mm (4") high concrete housekeeping pads, minimum 100 mm (4") wider and longer than equipment base dimensions.
- .3 Supply dimensioned drawings, templates, and anchor bolts for proper setting of equipment on bases and pads. Be responsible for required levelling, alignment, and grouting of equipment.
- .4 Submit to Consultant for review, dimensioned shop drawings of structurally designed bases for support of large, heavy equipment. Indicate on shop drawings total weight of base, reinforcement, and equipment for which it is required.
- .5 Perform work within formwork contractor's schedule. Failure to meet formwork schedule will result in Electrical Division Contractor being responsible for providing concrete work including formwork and reinforcing steel, to standards of Division 03.
- .6 Unless otherwise noted, support equipment suspended above floor level with suitable welded or bolted prime coat painted structural steel angles or channels bracketed to wall or secured by hanger rods.

3.17 Concrete Work

- .1 Unless otherwise noted, concrete required for electrical work is to be provided as part of Work of Division 03. Coordinated exact requirements (sizes, locations) with General Trades Contractor.
- .2 Layout, mark, coordinate and work with Division 03 contractor as required for installation of concrete necessary for duct banks, housekeeping pads, cubed openings, etc.

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3.18 Excavation & Backfill

- .1 Unless otherwise noted, excavation and backfill work required for electrical work is to be done as part of work of Division 02 or 31, except for final hand grading work and backfill to 450 mm (18") above service which is to be done as part of electrical work. Mark out location and routing of excavation required for work as well as required depth. Ensure that bedding is graded to provide proper drainage for ducts as directed by Consultant.
- .2 Inverts and locations of existing site services may have been site surveyed and approximate location may be shown on drawings. Confirm that local utilities have performed locates and marking out. Ensure inverts and locations are correct, prior to commencement of work. Where discrepancies are found, immediately inform Consultant, and await direction.
- .3 Ensure that work is inspected by Consultant before covering and backfilling. Failure to do so prior to backfilling will require re-excavating work and re-backfill at no additional cost to Owner.

3.19 Cutting, Patching & Core Drilling

- .1 Unless otherwise provided by General Trades, perform cutting, patching, and core drilling of existing building required for installation of your work. Perform cutting in a neat and true fashion, with proper tools and equipment. 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 Owner and 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 Where conduits and/or conductors penetrate existing construction, core drill or saw cut an opening. Size openings to leave 13 mm (1/2") clearance around conduit and/or conductors, and pack and seal and void between opening and conduit and/or conductor for length of opening with ULC listed and labelled material in accordance with article titled "Firestopping And Smoke Seal Materials" specified herein this Section.
- .4 Do not cut or drill any existing work without approval of Owner and coordination with Consultant. Be responsible for damage done to building and services caused by cutting or drilling.

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- .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. Be responsible for damage to existing services caused by core drilling or cutting openings. Coring is not permitted through concrete beams or girders.
- .6 Fire stop and seal openings as specified, and patch as required before end of workday. No openings are to be left open overnight unless approved by Owner and coordinated with Consultant.

3.20 Finish Painting of Electrical Work

- .1 Unless otherwise noted, finish painting of exposed Electrical Divisions work is to be performed as part of work of Division 09.
- .2 Provide identification painting for electrical distribution equipment in accordance with application requirements of Division 09. Confirm exact finish colours with Consultant. Equipment requiring special colour identification painting to include but not be limited to following:
 - .1 pull boxes and junction boxes;
 - .2 communication system conduit;
 - .3 genset exhaust piping.
- .3 Spray painting is not permitted unless approved in writing by Owner and reviewed by Consultant.

3.21 Conduit Provisions for Miscellaneous Systems

- .1 Provide following components to accommodate future installation of various miscellaneous systems by system installers who are to provide equipment and wiring:
 - .1 conduit - diameters as sized on drawings with non-metallic fish wires or pull cords and suitable bushings for conduit terminations, and as specified in Part 2; provide labelling at each end to clearly identify each conduit run with respect to system and path;
 - .2 outlet boxes - standard galvanized steel, each complete with a blank type faceplate, and as specified in Part 2;
 - .3 pull boxes, junction boxes, back boxes and sleeves - and as specified in Part 2.
- .2 Miscellaneous systems are typically as shown on drawings. Unless otherwise noted on drawings, provide dedicated conduit runs for each system. Coordinate sizes of boxes with respective system vendors to ensure proper sizing to accommodate components and that allows for wiring bending radii. Confirm conduit and box requirements also with system vendors.
- .3 Provide pull boxes in conduit runs longer than 30 m (100') or having more than two - 90 bends. Size pull boxes to be at least 8 times entering conduit in length. Pull box sizes to comply with respective system standards.

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- .4 Leave conduits free and clear of all obstructions and terminate as required. Equip terminations with bushing, and clearly identify each run. Provide fish wires in all empty conduits. Run telecommunications conduits to comply with separation from sources of electromagnetic radiation as per standard ANSI/TIA/EIA-569. Site bend telecommunications conduit elbows to comply with system conduit bending radii requirements.
- .5 Confirm exact requirements and locations of equipment with Consultant and respective system installers prior to roughing-in.
- .6 Refer to system riser diagrams on drawings.
- .7 Quantities for outlets to be as per floor plan drawings and not riser diagrams.

3.22 Door Hardware

- .1 Generally, Division 08 or another Division not under scope of electrical Contractor, is responsible for supply and installation of door alarm contacts, door holders, electric strikes, electromagnetic locks, door operator controls, power supplies, door controllers, central electromagnetic lock release controller and other door hardware. Coordinate and confirm with General Trades Contractor and respective equipment vendors (door hardware / security) exact responsibility of each Division of the Work.
- .2 Confirm product and wiring requirements, back box requirements and wiring installation requirements with door hardware trades and with equipment vendors. Provide required wiring in conduit from each device to respective controllers, between each device, and to central control panel and for power connection to such controls and devices. Provide line level voltage power feeds to equipment as required.
- .3 For controls and interconnections between devices, when such device terminations are responsibility of others, supply and run interconnecting wiring in conduit to devices and allow spare length of 1.8 m (6') coiled wiring at each end for final termination to devices by others.
- .4 For applications of electro- magnetically held closed doors, engage fire alarm system vendor to provide fire alarm type pull station with auxiliary contacts as required for interconnection of electro- magnetic door hardware and fire alarm system for release of doors. Provide required wiring in conduit and connections. Coordinate pull station requirements with fire alarm system vendor.
- .5 Exact type of door alarm contacts to be coordinated with door construction and finishes. Contacts to generally be recessed mounted and wiring be installed in concealed conduits. Confirm exact requirements with door hardware / security vendor and General Trades Contractor.
- .6 Where controls are located remotely from door locations, such as in closets, provide wiring in conduit and extend from local above door junction boxes and devices as required with homeruns back to closet location of equipment and leave slack wiring for terminations by others. Confirm exact requirements with door hardware / security vendor and General Trades Contractor.
- .7 Drawing details issued with electrical drawings are for pricing reference only and are based on assumptions. Obtain detailed design drawings from successful door hardware / security vendors and provide wiring in conduit to coordinate with and accommodate final systems designs. Coordinate with General Contractor.

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for products and accessories.

PART 2 - PRODUCTS

2.1 Basic Materials

- .1 Ground Rods: Copper-clad steel, 20 mm (3/4") diameter circular cross-sectionalized, with driving cap and bronze tip, overall length of 3 m (10') long.
- .2 Ground Conductors: Solid copper, insulated and bare to suit application and code requirements; and bond conductors.
- .3 Ground Connections:
 - .1 Below Grade: Cadweld as supplied by Erico Products or approved equal, exothermic-welded type connectors.
 - .2 Above Grade or in Manholes: Compression type connectors; Exothermic connections permitted above grade if approved by Consultant.
 - .3 When making ground and bonding connections, apply a corrosion inhibitor to contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between metals used.
- .4 Ground Pit: Flush in grade grounding pits with following features:
 - .1 removable cast concrete cover with recessed lifting handle;
 - .2 cast iron or precast concrete pit;
 - .3 ground rod, ground clamps and grounding conductors as required;
 - .4 clay sewer tile for proper drainage.
- .5 Gravel/Stones: Provide gravel and crushed stones as required by local governing authorities to suit application. Layers to be of thickness not less than required by local governing authorities.
- .6 Miscellaneous ancillary components to complete grounding and bonding work to requirements of local governing electrical authority and codes.

2.2 Telecommunications

- .1 Telecommunications Equipment Rack And Cabinet Ground Bars: solid copper ground bars designed for mounting on framework of open or cabinet-enclosed equipment racks with minimum dimensions of 6 mm (1/4") thick by 20 mm (3/4") wide; At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks. Where bolting to painted surfaces, use paint piercing type washers.
- .2 Ground Conductor for Grounding Grid and Associated Connections: Number 3/0 AWG bare, 7-strand medium hard-drawn copper unless indicated otherwise.
- .3 Ground Braid: constructed from flat 98% conductivity tinned copper grounding braid.

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PART 3 - EXECUTION

3.1 General Grounding & Bonding Requirements

- .1 Provide required grounding and bonding work in accordance with drawings, local governing electrical authority, governing authorities having jurisdiction and local governing electrical inspection authority. Provide local governing electrical utility grounding requirements for stations, vaults and electrical rooms, as applicable. Confirm requirements with local governing electrical utility.
- .2 Provide applicable grounding requirements for local electrical utility pad mounted transformer in accordance with local utility requirements. Provide a ground electrode consisting of minimum four (4) ground rods (unless otherwise detailed or otherwise required by local utility) driven into grade in an arrangement as required and interconnected with minimum No. 3/0 bare copper conductor. Drive and bury ground rods at depth in accordance with local governing electrical code. Connect transformer to ground electrode with 2 runs of minimum No. 3/0 bare copper conductor.
- .3 Ground and bond other equipment such as transformers, switchboards, panelboards, and similar metal work to perimeter ground bus. Provide minimum No. 3/0 insulated ground wire from ground bus in electrical rooms to switchboards, transformers, structure, floor, etc.
- .4 Effectively bond metallic pipe services such as, gas mains, water mains, and dry risers, to main grounding terminal at their point of entry. Make connections to services with purpose-made grounding clamps.
- .5 When buses are in place, bolts have been tightened, and lugs have been installed, coat entire installation with two (2) 100% covering coats of suitable shellac to prevent bus from oxidizing.
- .6 Throughout complex, solidly ground systems and make required grounding connections to electrical devices and apparatus. Ground conductors to be insulated copper wire connected with approved fittings in accordance with local governing electrical code.
- .7 Effectively bond building structures to main grounding system (grid).
- .8 Provide separate insulated ground wire for each isolated ground receptacle.
- .9 Connect grounding conductors to motors 10 hp and above or circuits 20A or above, with a solderless terminal and a bolt tapped to motor frame or equipment housing. Connect to smaller motors or equipment by fastening terminal to a connection box. Connect junction boxes to equipment grounding system with grounding clips mounted directly on box or with machine screws. Completely remove paint, dirt, or other surface coverings at grounding conductor connection points so good metal-to-metal contact is made.
- .10 Ground metal sheathing and any exposed metal vertical structural elements of buildings. Ground metal fences enclosing electrical equipment. Bond any metal equipment platforms which support electrical equipment to equipment ground. Bond rooftop equipment.
- .11 Provide service conductors exceeding 400 amperes with minimum No. 3/0 AWG grounding conductors, unless otherwise noted.

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- .12 Ground and bond various telecommunications, audio visual systems, security, life safety and control systems in accordance with respective system manufacturers recommendations and in accordance with local governing electrical code requirements.
- .13 Make ground connections in slab or buried underground using local governing electrical authority approved welded copper connections.
- .14 Ground conductors not sized on drawings are to be sized in accordance with local governing electrical authority requirements. Ground conductor size is to be no smaller than requirements specified herein this article or on drawings.

3.2 Additional Telecommunications Grounding

- .1 Comply with TIA/EIA-607 grounding and bonding requirements.
- .2 Provide wire and hardware required to properly ground, bond, and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.
- .3 Ground bonding jumpers to be continuous with no splices. Use shortest length of bonding jumper possible.
- .4 Provide ground paths which are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to building grounding electrode. Resistance across individual bonding connections to be 10 milliohms or less.
- .5 Bonding Jumpers:
 - .1 Use insulated ground wire of size and type if identified on Drawings if not identified, comply with local governing code, but which is to be a minimum of No. 6-AWG insulated copper wire.
 - .2 Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
 - .3 Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.
- .6 Bonding Jumper Fasteners:
 - .1 Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten plain end of a bonding jumper wire by slipping this plain end under conduit strut clamp pad; tighten clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.
 - .2 Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover; e.g., zinc-plated acorn nuts, on any bolts extending into wireway or cable tray to prevent cable damage.
 - .3 Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
 - .4 Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.
- .7 Building Ground Busbars:

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- .1 Provide busbar hardware at each communications room and connect to pigtail extensions of building grounding ring.
- .2 Verify that ground ring pigtail is same type and size conductor used for main building grounding ring.
- .8 Telecommunications Ground Busbars:
 - .1 Provide communications room telecommunications ground busbar hardware at cable tray height.
 - .2 Connect busbar to building ground busbar located in same room using two-hole compression lugs and a grounding jumper of same size as pigtail extension of main building grounding ring (usually 3/0 AWG).
- .9 Ground metallic conduits, wireways, and other metallic equipment located away from equipment racks or cabinets to cable tray pan or telecommunications ground busbar, whichever is closer, using insulated No. 6-AWG ground wire bonding jumpers.
- .10 Ground metallic conduit at each end using No. 6-AWG bonding jumpers.
- .11 Comply with cable tray manufacturer grounding and bonding recommendations. Bond metallic structures of wireway to provide 100% electrical continuity throughout wireway system.

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings of products specified in this Section.
- .2 Submit copies of documents requested herein, testing reports, certificate of approvals, and commissioning sheets.

PART 2 - PRODUCTS

2.1 Vibration Control & Seismic Restraint

- .1 Electrical equipment installation is to meet local governing authority having jurisdiction and code seismic requirements and additional requirements for vibration isolation.
- .2 Provide labour, materials, and equipment required and necessary to seismically restrain electrical equipment and equipment bases including concrete pads, and guarantee function of materials and equipment supplied.
- .3 Make electrical connections to vibration-isolated equipment with flexible conduit or other flexible means acceptable to Consultant and local governing authority having jurisdiction so as not to restrict maximum anticipated movement of equipment under seismic excitation movement.
- .4 In event that inadequate isolation is provided by isolation product Manufacturer isolation package, be responsible for improving isolation to an acceptable standard at no additional cost to contract. Isolation product Manufacturer seismic restraint engineer to verify that seismic restraints and combination isolator/restraints intended for use on project are fit for intended purpose. Be responsible for ensuring that Manufacturer seismic restraints are in compliance with applicable local building code requirements for Place of Work.
- .5 Provide additional seismic requirements for suspended electrical raceways, luminaires, and other equipment as per governing local authority requirements and requirements of current codes and by-laws.
- .6 Acceptable manufacturers of seismic restraints include:
 - .1 Vibro-Acoustics;
 - .2 Mason Industries;
 - .3 Kinetic Noise Control;
 - .4 Eaton B-Line.

PART 3 - EXECUTION

3.1 Installation

- .1 Comply with seismic restraint Engineer and manufacturer installation recommendations.

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- .2 Obtain required training from Manufacturer representative on any special installation procedures. Install components in accordance with Manufacturer instructions to suit specific installation requirements.
- .3 Test, adjust, and certify installation. Submit copies of test report to Consultant.

3.2 Inspection

- .1 Inspect for removal of break away hardware to ensure proper torques of installed systems.
- .2 For non-visually verifiable product, manufacturers to verify proper torque for a minimum 10% of application. Document torques for applications per Manufacturer instructions.

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PART 1 - GENERAL

1.1 Not Used

PART 2 - PRODUCTS

2.1 Not Used

PART 3 - EXECUTION

3.1 General Electrical Work Testing

- .1 In addition to tests required by local governing authorities having jurisdiction, local codes and regulations, perform following:
 - .1 after luminaires, switches, receptacles, motors, signals, etc., are installed, whether same are installed as part of this Division or by other Divisions (telephone systems excepted), test work to ensure that there are no leaks, grounds or crosses;
 - .2 establish and ensure proper motor rotation - measure full load running currents and check overload elements - report to Consultant any discrepancies which are found; existing motors which have been worked on (disconnected and reconnected) must be checked with rotation meter to ensure proper rotation; be responsible for any damage caused by reverse rotation;
 - .3 demonstrate to Consultant that branch circuit voltage drop is within specified units;
 - .4 ensure that devices are commissioned and operable.
- .2 Document results into distribution system testing report. Report must state that testing was successful and Work complies with project documents, applicable CSA standards, and other applicable governing codes and requirements.

3.2 Systems Inspection, Testing, Start-Up & Verification

- .1 When each system and each major piece of equipment installation is complete and ready for acceptance, include for system and equipment manufacturer or Manufacturer authorized representative to visit site to provide system inspection, testing, start-up, and verification. Perform following:
 - .1 check component connections and overall installation;
 - .2 adjust sound systems for high quality, distortion free performance, free from noise, cross-talk, hum or other interference;
 - .3 test and adjust system and ascertain that components are as specified and ensure that products operate as designed;
 - .4 provide start-up procedures for systems and equipment;
 - .5 verify and certify system component operations;
 - .6 prepare, document and evaluate test results;

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- .7 authenticate test results with signature of authorized testing Engineer/Technician;
- .8 check and verify nameplates;
- .9 provide maintenance and operating instructions to Owner's personnel.
- .2 Perform work properly documented, and in accordance with Manufacturer instructions and recommendations.
- .3 Perform work under presence of Owner/Consultant/Commissioning Agent at times approved by Owner and reviewed with Consultant.
- .4 Provide these requirements after each phase (as applicable) to allow Owner option to use area of phase of work. These requirements are also to be provided prior to applying for Certificate of Substantial Performance of the Work of project.
- .5 Include for manufacturers authorized technicians of equipment/systems integrated to equipment/systems being tested to be onsite during full integration testing. Coordinate with each manufacturer.
- .6 When system inspection, testing, start-up and verification specified above is complete, obtain from supplier/manufacturer (or where specified, independent inspection company) a test report with test sheets, and covering verification letter signed by authorized testing technician, stating that system or equipment has been inspected and tested, performs as specified and is ready for acceptance. Include date and time of testing, testing technician's name and specification section number test fulfilled.
- .7 Bind documents under cover and submit minimum one hard copy and electronic copy to Consultant.

3.3 Electrical Distribution System Testing & Verification

- .1 Provide services consisting of on-site engineering inspection, testing and verification of electrical distribution equipment and other systems and equipment. Perform work to standards of applicable local governing authorities, local electrical inspection authority and CSA Standards.
- .2 Services to be performed by an approved independent testing company and be initially conducted prior to system/equipment being energized and further testing when energized, and include following items, where applicable:
 - .1 testing, cleaning when necessary, and calibrating relays and circuit breaker trip devices (calibration of protective devices to conform to requirements of approved coordination curves);
 - .2 function test of associated control devices;
 - .3 replacement of fuses destroyed during testing;
 - .4 an acceptance test in presence of Consultant;
 - .5 presence, for length of time required, of qualified and competent equipment Manufacturer service representative during start-up;
 - .6 carry out insulation resistance testing of outgoing feeders with respect to ground;
 - .7 inspection and testing of cables, bus duct, power panels, lighting panels, transformers, power receptacles and switches;

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- .8 inspection and testing of electrical devices and communication system components installed in service consoles, headwalls, furniture systems, etc., whether or not devices are supplied by Electrical Divisions;
- .9 inspection and testing of motor control centres, starters and variable frequency drives;
- .10 inspection and testing of lighting control systems including central control systems, low voltage relays, sensors and dimming controls; ensure that devices perform in conformance with ASHRAE 90.1 requirements;
- .11 verification and certification work of equipment and systems;
- .3 Perform services procedures properly documented, and in accordance with Manufacturer instructions and recommendations.
- .4 Forward to Consultant for review, minimum 3 hard copies and electronic file of engineering and testing report.
- .5 Where relays, breakers, etc., do not perform to Consultant reviewed coordination curves, revise as part of work.
- .6 Provide visual and mechanical inspection of ground system and verify that it is in compliance with issued documents and local governing electrical code requirements.
- .7 Additionally, perform testing of lighting control systems and devices to ensure conformance with ASHRAE 90.1 requirements.
- .8 Acceptable companies to provide this work are to be independent of successful manufacturers providing distribution system equipment and include:
 - .1 G.T. Woods;
 - .2 AC Tesla;
 - .3 Pelikan Inc;
 - .4 Eaton Electric Services Division;
 - .5 Schneider Electric Services Division;
 - .6 Siemens Electric Services Division.

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for products and accessories.
- .2 Submit samples of conductors, when requested by Consultant.

PART 2 - PRODUCTS

2.1 General Power Cables

- .1 CSA approved, ULC labelled and certified. Unless otherwise noted, conductors to be copper and be suitable for applications as noted in governing local electrical code.
- .2 RW90 CSA certified, single copper conductor to CSA C22.2 No. 38, 600/1000 volts, maximum 90°C (194°F) conductor temperature, -40°C (-40°F) minimum installation temperature, X-link polyethylene (XLPE) insulation, colour coded.
- .3 T90 Nylon, CSA certified, single copper conductor to CSA C22.2 No. 75, 600 volts, maximum 90°C (194°F) dry conductor temperature, -10°C (-14°F) minimum installation temperature, PVC insulated, nylon covered.
- .4 RWU90 CSA certified, single copper conductor to CSA C22.2 No. 38, 1000 volts, maximum 90°C (194°F) conductor temperature, -40°C (-40°F) minimum installation temperature, extra thickness X-link polyethylene (XLPE) insulation suitable for wet and buried installations, colour coded.
- .5 AC90 flexible armoured cable with "RW90" conductors and bare copper ground conductor and overall interlocked aluminium tape armour, to CSA C22.2 No. 51 (R2004).
- .6 Solid conductors to and including No. 10 AWG; stranded conductors in sizes larger than No. 10 AWG; branch circuit conductors constructed of 98% conductive copper; and approved for minimum 600 volts.

2.2 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 volts, rated pressure type connectors.
- .3 For conductors sized 3/0 and greater, provide long barrel double crimp, 2 hole compression type lug connectors, unless otherwise noted.

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2.3 Fire Rated Cables

- .1 Pentair - Pyrotenax, model "System 1850", CSA certified, ULC listed and labelled, FM Specifications tested, 600 V, type MI, 2 hour fire rated, copper sheathed, copper conductor, highly compressed magnesium oxide mineral insulated power cable. Connectors for copper-sheathed mineral conductors to be cable manufacturer proper connectors and accessories as recommended by manufacturer to suit specific applications.
- .2 Manufacturer termination kits: Pyropak epoxy sealing compound kits and "Quick Term" connectors; connectors for MI conductors to be cable manufacturer proper connectors and accessories as recommended by the manufacturer to suit specific applications.
- .3 Cable clips and straps as recommended by cable manufacturer to suit specific installation application. In applications of dissimilar materials, provide tape to insulate cabling and hardware.
- .4 Brass plates for cable openings in ferrous metal enclosures.
- .5 Include for required cable manufacturer accessories and identification labelling.
- .6 Include for manufacturer authorized technician to be present on site for initial coordination with installing personnel on review of proper installation of cabling runs and termination of cabling. After completion of Work, manufacturer technician to review installation work and provide in writing that installation work has been performed to satisfaction of cable manufacturer.
- .7 Acceptable manufacturer of fire rated MI type cables is Pentair Thermal Management.

2.4 Standard Control & Communications Cables

- .1 ULC listed and labelled, CSA certified to C22.2 No. 127, No. 18 AWG "TEW" thermoplastic insulated, solid copper wire rated for 600 volts service, and 105°C (220°F) conductor temperature, complete with required number of copper conductors and colour coding.
- .2 Nexans, "Securex II", FAS 105, 300 volts, 105°C (220°F) conductor temperature rated fire alarm system flexible armoured cable with solid copper conductor, shielding, flame retardant PVC insulation and red colour outer overall jacket, ULC listed and labelled and CSA certified to C22.2 No. 208.

2.5 Conductor Pulling Lubricant

- .1 IDI Electric (Canada) Ltd., "Ideal Yellow 77" or "Wire Lube" as required.

2.6 Teck Cables

- .1 Nexans, "Firex II Teck" cables as follows:
 - .1 certified to CAN/CSA C22.2 No.131, Type TECK 90 Cable;
 - .2 rated for outdoor, weather resistant and wet locations applications;
 - .3 600/1000 V rated;
 - .4 Conductor: Bare, Soft drawn, Class B Compact or Compressed Stranded Copper conductors per ASTM;
 - .5 insulation: chemically cross linked thermosetting polyethylene (XLPE);

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- .6 bonding conductor (1/C Cable): Soft drawn bare copper;
- .7 inner jacket: sunlight resistant PVC jacket tightly applied over assembly, to prevent slipping of core in a vertical position;
- .8 armour: flexible interlocked aluminum armour, over inner jacket for mechanical protection;
- .9 overall PVC jacket rated -40°C (-40°F).
- .10 barrier tape over shield.
- .2 Acceptable manufacturers are:
 - .1 Nexans;
 - .2 Prysmian Cables (Pirelli);
 - .3 General Cable;
 - .4 Aetna Cables;
 - .5 Kerite Company.

PART 3 - EXECUTION

3.1 Project Conditions

- .1 If identified in documents, verify that field measurements and conditions are as identified.
- .2 Cable routing on drawings is schematic and approximate. Route cable as required to meet project conditions. Determine exact routing and lengths on site.
- .3 Confirm fire protection ratings of construction to ensure that rooms and paths of conductors are fire rated in accordance with local governing codes requirements. Include fire rated conductors as required to meet local governing codes requirements.

3.2 Co-Ordination

- .1 Co-ordinate work with work provided under other electrical work and work of other trades.
- .2 Determine required separation between cable and other work.
- .3 Determine cable routing to avoid interference with other work.
- .4 Submit any alternative cable routing to Consultant for review prior to proceeding with work.

3.3 Installation of Conductors

- .1 Provide required conductors. Ensure fire rated conductors are provided for applications as required by local governing codes, standards and local governing authorities.
- .2 In applications where multiple conductors in conduit are being run, provide a trapeze configuration of metal C-channels and threaded rod hangers to support cable/conduit from ceiling slab. Wall mounted cable/conduit brackets and ring type conduit hangers may also be permitted in applications approved by Consultant. Provide required cable support system accessories which are not specified herein or shown on drawings but are required for proper installation.

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- .3 Conductors, unless otherwise noted, to be as follows:
 - .1 underground inside or outside building and for non-climate controlled areas - "TWU" or "RWU90";
 - .2 for connections to electric heating coils in supply air ductwork systems, and for connections to other electric heating equipment where use of 90 degrees C. rated conductors are recommended by heating equipment manufacturer - "RW90";
 - .3 for conductors requiring fire rating by current regulations and local codes including feeders for emergency systems, fire fighter's elevators, fire alarm systems, other life safety systems and for applicable signal and control circuits of these systems - type "MI" CSA approved, ULC listed and labelled, 2 hour fire rated, copper sheathed mineral insulated copper conductors;
 - .4 climate controlled areas branch circuit wiring in accessible ceiling spaces and within stud wall construction consisting of drops down to luminaires and drops down stud walls to devices and in furniture systems - "AC90" flexible armoured cable ("BX") (maximum 6m (20') run permitted);
 - .5 for climate controlled areas wiring except as noted above or specified elsewhere in Specification or as noted on drawings - "T90 Nylon" or "RW90".
- .4 Support flexible armoured cable in ceiling spaces and in stud wall construction with steel 2 hole cable straps to "Code" requirements. Flexible armoured cables must run in a neat manner parallel to building lines. Utilize centralized conduit runs to maintain maximum permitted runs of flexible armoured cables as specified. Provide insulating grommet at cut ends of flexible armoured cable to protect conductor insulation.
- .5 Install compression connectors with proper dies and compression tool as per connector manufacturer instructions. Install cold shrink tubing and associated materials as per manufacturer instructions.
- .6 Low voltage conductors to typically be No. 18 AWG "TEW" except for use in fire alarm system applications, unless otherwise noted. Provide specified fire alarm cables for fire alarm system applications or security system applications as approved by Code and local governing authorities. Conductors not installed in conduit or raceways to be fire insulated rated in accordance with latest governing Code Flame Spread requirements.
- .7 Generally, conductor sizes are indicated on drawings. Such sizes are minimum requirements and must be increased, where required, to suit length of run and voltage drop in accordance with applicable conductor voltage drop schedule appended to end of this Section.
- .8 Do not use conductors smaller than No. 12 AWG in systems over 30 volts, unless otherwise noted. Do not use conductors smaller than No. 6 AWG for exterior luminaire wiring unless otherwise noted.
- .9 Colour code conductors throughout to identify phases, neutrals and ground by means of self-laminating coloured tape, coloured conductor insulation, or properly secured coloured plastic discs. Colours, unless otherwise noted, to be as follows:
 - .1 Phase A - red;
 - .2 Phase B - black;
 - .3 Phase C - blue;
 - .4 Ground - green;

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- .5 Neutral - white;
- .6 Control - orange.
- .10 Use "French Chalk" or talcum powder for pulling in isolated power centre "load" side wiring.
- .11 When pulling wires into conduit use lubricant and ensure that wires are kept straight and are not twisted or abraded.
- .12 Control conductors, in addition, to be numbered with Brady Ltd. or Electrovert Ltd. Z type markers.
- .13 Colour code conductors for communications systems in accordance with system component manufacturer recommendations.
- .14 Neatly secure exposed wire in apparatus enclosures with approved supports or ties.
- .15 Install low voltage conductors in conduits, unless otherwise noted within Documents.

3.4 Installation of Fire Rated Conductors

- .1 Submit with shop drawings, copy of manufacturer detailed installation manual and testing procedures. Provide minimum 2 hour fire rated type "MI" CSA approved, ULC listed and labelled, mineral insulated copper conductors for following:
 - .1 emergency feeders from generators to transfer switches;
 - .2 feeders to elevators;
 - .3 feeders to fire pumps and sprinkler pumps;
 - .4 feeders to smoke venting fans;
 - .5 feeders to emergency lighting panel boards;
 - .6 feeders to fire alarm control panels and transponders;
 - .7 fire alarm risers;
 - .8 feeders as required by Code requirements;
 - .9 fire alarm system feeders as shown interconnecting existing fire alarm system and additional system;
 - .10 applicable local governing code required applications for control and signalling conductor circuits of and between life safety equipment and systems;
 - .11 feeders and conductors as noted on drawings.
- .2 Provide fire rated type "MI" conductors for specific feeders as required and as noted. Install type "MI" copper sheathed, mineral insulated conductors for applications noted above and as shown on drawings in strict accordance with the manufacturer instructions and recommendations. Refer to latest issue of Pyrotenax MI cable Commercial Wiring Installation Manual. Installation must be in a neat and professional manner as per manufacturer approval. Make arrangements for manufacturer technician to provide onsite services as specified.
- .3 Provide Unistrut C-channels, clips, wall brackets, etc., as required and as recommended by cable manufacturer to suit the on-site installation conditions. Provide system of Unistrut hangers and rods spaced at minimum 1.2 m (4') but which must be confirmed with cable manufacturer, for running of cables. Where clips and other hardware are in contact with cables, insulate cables/hardware with suitable tape as per cable manufacturer recommendations for applications of dissimilar metals.

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- .4 Make terminations of "MI" conductors with manufacturer approved components and "Pyropak" or "Quick Term" connectors in accordance with the manufacturer recommendations. Obtain proper tools for cable terminals from the cable manufacturer. Terminations must be completed immediately once started to avoid moisture ingress from the surrounding air. Connections to ferrous cabinets for single conductor cables shall incorporate brass plates sized as required and as per cable manufacturer requirements. Brass plates shall be complete with required drilled and tapped holes. For 99°C applications, cable lugs shall be temperature rated as such.
- .5 When pulling cable, apply pulling tension to the conductor not in the sheath of the cable. Limit cable pulling tension to as recommended by cable manufacturer.
- .6 Terminate cable in the equipment with termination kits as per cable manufacturer instructions.
- .7 Installation of cable splices and terminations to be witnessed by manufacturer authorized technician. Perform terminations in accordance with cable manufacturer instructions
- .8 Ground cabling as per cable manufacturer instructions and as per local governing electrical code requirements.
- .9 Take necessary precautions when handling cable on reel to ensure that no damage will result in the uncoiling process.
- .10 Where cables penetrates fire rated construction, provide ULC listed and labelled, fire stopping and smoke seal materials or fittings to protect integrity of fire rated construction. Install work in compliance with ULC standards and where required by local governing codes, provide tray type suitable for plenum environments.
- .11 Test MI cables after installation, in strict accordance with cable manufacturer instructions. Megger terminations to check that insulation resistance is acceptable to cable manufacturer. Prior to completing each termination, test insulation resistance and follow cable manufacturer drying procedures until resistance reaches cable manufacturer listed acceptable level.
- .12 Provide for cable manufacturer authorized representative to review the installation, termination, splicing and testing of installed cables. Prepare report consisting of test sheets with results of cables tested and a certificate of verification signed by testing engineer/technician. Report to include copy of cable manufacturer signed inspection letter documenting that work was performed to satisfaction of manufacturer. Submit minimum 3 hard copies and electronic copy to Consultant.

3.5 Installation of Teck Cables

- .1 Provide cables as required for specific applications. Handle, install, and terminate in accordance with manufacturer recommendations and instructions and as herein specified.
- .2 When pulling cable, apply pulling tension to conductor not in sheath of cable. Limit cable pulling tension to as recommended by cable manufacturer.
- .3 Terminate cable in equipment with lugs and termination kits as per cable manufacturer instructions.
- .4 Installation of cable splices and terminations to be made by personnel skilled in this type of work.

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- .5 Ground shielding as per cable manufacturer instructions.
- .6 Take necessary precautions when handling cable on reel to ensure that no damage will result in uncoiling process.
- .7 No splices are allowed unless justified by cable pulling tension calculations and approved in writing by Consultant. Obtain approval of splice location from Consultant.

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APPENDIX - VOLTAGE DROP SCHEDULES

MAXIMUM BRANCH WIRING DISTANCE FOR 120 VOLT SYSTEM AT 3% VOLTAGE DROP

WIRE SIZE	BREAKER SIZE (AMPERES)	15	20	30	40	50	60	70	80	100
	MAX LOAD AT 80% (AMPERES)	12	16	24	32	40	48	56	68	80
No. 12	-	24.4	18.3	-	-	-	-	-	-	-
No. 10	-	38.1	29.0	19.1	-	-	-	-	-	-
No. 8	-	59.4	44.2	30.5	22.9	-	-	-	-	-
No. 6	-	91.4	70.1	47.2	35.1	28.2	23.6	-	-	-
No. 4	-	-	109.7	73.2	54.9	42.7	38.1	32.0	27.4	-
NO. 2	-	-	-	114.3	85.3	68.6	57.9	50.3	41.1	35.0
No. 1	-	-	-	-	103.6	85.3	73.2	61.0	54.9	43.4
No. 1/0	-	-	-	-	128.0	102.9	85.3	73.2	64.0	48.8
No. 2/0	-	-	-	-	-	121.9	100.6	86.9	74.7	60.9
No. 3/0	-	-	-	-	-	-	118.1	102.1	88.4	70.1
No. 4/0	-	-	-	-	-	-	-	120.4	102.9	83.8
250 MCM	-	-	-	-	-	-	-	-	114.3	91.4
300 MCM	-	-	-	-	-	-	-	-	-	103.6

Note: Distances indicated in metres from panel to load for single phase.

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for following:
 - .1 cable tray with copy of ULC certificate;
- .2 Submit detail drawings of proposed routing and dimensions.
- .3 Submit sample of trays.

PART 2 - PRODUCTS

2.1 Basket Cable Tray

- .1 Legrand-Cablofil, CSA approved and labelled, basket type cable tray system complete with factory made couplers, fittings, tee sections, elbows, universal dropouts, etc., and required supporting and installation accessories. Features include but are not limited to following:
 - .1 minimum 300 mm x 100 mm (12" x 4") unless otherwise noted on drawings;
 - .2 welded wire construction of minimum 5 mm (0.197") diameter carbon steel wires and hardware, conforming to requirements of ASTM A510 Grade 1008 with black powder coated finish paint to ASTM D 3451;
 - .3 continuous, rigid, welded steel wire mesh cable tray system;
 - .4 top wire safety edge;
 - .5 wire mesh welded at intersections;
 - .6 mesh sections having minimum one (1) bottom longitudinal wire along entire length;
 - .7 warning signs;
 - .8 accessories included as required.
- .2 Prior to start of work, prepare and submit detailed installation drawings, including plans, elevations and sections of proposed tray and routing. Coordinate such drawings with coordination drawings of trades. Include for design calculations to determine load limitations.
- .3 Tray to not have sharp edges that may damage cables during running of cables. Final finish to be smooth with no burrs that may damage cables.
- .4 Use manufacturer trained and certified installers to perform work. Use tools as recommended by and supplied by tray manufacturer. Utilize manufacturer supplied cutter for cutting tray. Submit with shop drawings, copies of installing technicians' certificates of training on respective tray systems.
- .5 Provide support of a trapeze configuration containing horizontal hanger brackets and vertical threaded rods on each side. Secure rods to brackets as per system manufacturer instructions. Space supports at maximum 1.5 m (5'), to provide support of loads up to 53 kg/m (36 lbs per foot).

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- .6 Where cable tray penetrates fire rated construction, provide ULC listed and labelled, fire stopping and smoke seal materials or fittings to protect integrity of fire rated construction. Install work in compliance with ULC standards and where required by local governing codes, provide suitable for plenum environments.
- .7 Provide tray complete with grounding/bonding provisions, fittings, tee sections, elbows, universal dropouts, expansion fittings, etc., and required supporting and installation accessories. Provide dividers to separate various system cabling to a degree confirmed by Consultant, but typically two (2) dividers in a 300 mm (12") wide tray. Provide conduit fittings where conduits enter tray and provide dropouts at ends where cables exit/enter. Supply cable installation rollers for pulling cables safely into tray. System accessories to be supplied by system manufacturer and be as recommended by system manufacturer for specific applications.
- .8 Acceptable manufacturers are:
 - .1 Legrand-Cablofil;
 - .2 Cooper "Flextray";
 - .3 Eaton B-Line;
 - .4 Canadian Electrical Raceways;
 - .5 Hubbell;
 - .6 WBT.

PART 3 - EXECUTION

3.1 Installation of Cable Tray

- .1 Provide sample of tray and detailed drawing layout of work prior to start of work, accurately dimensioned and showing required routing, penetrations, connections, bends, supports, etc.
- .2 Obtain required training from manufacturer representative on any special installation procedures. Install tray in accordance with manufacturer instructions to suit specific installation requirements. Use manufacturer recommended tools for cutting and installing tray.
- .3 Drawings are diagrammatic and do not identify required changes in elevations and architectural features. Site measure exact routing and lengths. Provide detailed drawing layout of work prior to start of work, accurately dimensioned and showing required penetrations, connections, bends, etc.
- .4 Install and hang cable tray at maximum 1.5 m (5') centres and in accordance with manufacturer published literature employing horizontal bracket supported to ceiling slab by vertical threaded rod hangers. Do not secure assembly from ductwork, suspended ceiling structures, lighting, etc. Secure rod hangers directly to ceiling slab. Locate supports as not to interfere with removal or opening of covers. Typically locate spans at intervals $\frac{1}{4}$ span from supports, as recommended by tray manufacturer. Refer to drawing details and/or manufacturer instructions. Include for provision of required seismic restraints as to comply with local governing building code requirements.
- .5 Provide proper fittings in cable tray at points of conduit entry. Terminate conduits at or in tray with proper grommeted and bushed terminations.

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- .6 Equip tray with necessary wall flanges, dropouts, enclosures, reducers, fittings, and similar accessories required, maintaining effective free cross-sectional area of tray clear of obstructions that might damage conductor insulation during installation.
 - .7 Properly secure, adequately support and neatly harness conductors in tray. Seal cable tray penetrations of building fire barriers by means of ULC listed and labelled fire stopping and smoke sealing material.
 - .8 Provide continuous paths along entire lengths of cable tray to maintain proper ground continuity. Utilize system manufacturer proper grounding and bonding fittings and hardware. Ground and bond system as per local governing electrical code requirements.
 - .9 File smooth cuts to tray and re-touch with galvanizing compound.
 - .10 Install expansion connectors where cable tray crosses building expansion joints.
 - .11 After installation is complete, install warning signs on tray in visible locations.
 - .12 Inspect tray for rough finishing burrs, sharp edges, and mechanical deficiencies prior to installing of cabling. Eliminate these deficiencies to satisfaction of Consultant, prior to installing cables.

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Wiring Devices

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for products specified in this Section.
- .2 Do not order any device unless finishes have been reviewed and approved by Consultant.

PART 2 - PRODUCTS

2.1 Switches

- .1 Switches to be CSA approved, ULC listed and labelled devices.
- .2 Hubbell Canada Inc., HBL 1221 Series, CSA approved, heavy duty, industrial grade, back, and side wired, AC quiet action toggle type, 20 ampere, 120-277 V switches. Switches to include steel-nickel plated bridge, nylon toggle, one piece rivet-less copper alloy spring contact arm and terminal plate, silver cadmium oxide contacts, brass binding head screws, one piece integral grounding terminal and stainless steel automatic grounding clips. Provide single way, 2-way, 3-way, and key type to suit specific application requirements.
- .3 Hubbell Canada Inc. No. 1221-IL, CSA approved, heavy duty, specification grade, AC quiet action, illuminated polycarbonate handle toggle type, 20 ampere, 120-277 V switches.
- .4 Acceptable manufacturers are:
 - .1 Hubbell Canada Inc.;
 - .2 Cooper Wiring Devices (Arrow Hart);
 - .3 Legrand - Pass & Seymour;
 - .4 Leviton.

2.2 Receptacles

- .1 Receptacles to be CSA approved, ULC listed, certified and labelled devices.
- .2 Hubbell Canada Inc., No. BR15TR series, commercial specification grade, 15 ampere, 125 V, 2-pole, 3-wire grounding, tamper-resistant (safety shutter) duplex receptacles.
- .3 Hubbell Canada, No. GFR 5262SG / GFR 5362SG "AUTOGUARD" Series, extra heavy duty grade, 15/20 ampere, 125 V, duplex, ULC Class "A", Group One, tamper resistant, weather resistant ground fault circuit interrupting receptacles complete with automatic self-test diagnostics, green power ON LED, red ground fault LED and 10 kA short circuit current rating.
- .4 Hubbell Canada Inc., No. USB 15X2 "Style Line" series, CSA approved, ULC listed, tamper resistant, back and side wired, 15 ampere, 125 V

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- .5 Hubbell Canada Inc., No. BR15C2GRY/BR20C2GRY "Permanently marked" Plug load controlled series, industrial grade, permanently marked with two controlled faces symbol identifying controlled receptacle, CSA approved, ULC listed, back and side wired, nylon face/body construction, 15/20 ampere, 125v, grounding, duplex receptacles; for use with automatic outlet control systems, and with factory broken split circuit tab allowing control of half of receptacle; interconnected to control module relays of lighting control system or other building control systems.
- .6 Hubbell Canada, No. IG 5262, heavy duty, specification grade, 15 ampere, 125 V, duplex, orange colour, nylon construction, back, and side wired isolated receptacles.
- .7 Where noted that 20 A receptacles are required, include for "T" slot type of respective series of receptacles.
- .8 Colour of special switches and receptacles (unless specified above), to be as specified in PART 3 of this Section of Specification.
- .9 Special switches and receptacles not specified above are to be specified on drawings. Low voltage lighting controls are specified in Section titled Lighting Control.
- .10 Acceptable manufacturers are:
 - .1 Hubbell Canada Inc.;
 - .2 Cooper Wiring Devices (Arrow Hart);
 - .3 Legrand - Pass & Seymour;
 - .4 Leviton.

2.3 Faceplates

- .1 Grade 18 8, type 430, 1 mm (0.032") thick stainless steel, satin, brushed or natural finish, complete with a peel off protective plastic film, and stainless steel screws.
- .2 Hubbell Canada Inc., No. WP8E / WP8EH, NEMA 3R rated, CSA approved, ULC listed and labelled, single gang, vertical/horizontal mounting, weather-proof in-use, gasketed, cast aluminium faceplates for standard duplex receptacles in wet locations.
- .3 Acceptable manufacturers are as per switches and receptacles.

PART 3 - EXECUTION

3.1 Installation of Switches

- .1 Provide switches and install in electrical outlet boxes. Refer to drawings to determine flush or surface mounting requirements. Generally, flush mount devices in finished areas. Size electrical boxes to suit device requirements as per device manufacturer recommendations. Properly ground device to box and ground system as per code requirements and manufacturer instructions.
- .2 For pricing only, switches to be ivory for devices connected to normal power circuits.
- .3 Ensure that switches located adjacent to doors are located at strike side of door. Confirm door swing requirements on architectural drawings, not on electrical drawings.

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- .4 Coordinate installation of door switches with trades responsible for provision of doors and frames. Confirm exact locations of switches with Consultant to ensure optimum operation of switch to door position.
- .5 Confirm final switch finishes with Consultant. Do not order any devices unless final finishes have been approved by Consultant.
- .6 Additionally, refer to testing and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

3.2 Installation of Receptacles

- .1 Provide receptacles and install in electrical outlet boxes. Refer to drawings to determine flush or surface mounting requirements. Generally, flush mount devices in finished areas. Size electrical boxes to suit device requirements as per device manufacturer recommendations. Properly ground device to box and ground system as per code requirements and manufacturer instructions.
- .2 For pricing only, receptacles to be ivory for devices connected to normal power circuits.
- .3 Safety shutter type receptacles to be located where shown and required by code.
- .4 Install USB charger receptacles in extra deep boxes in accordance with manufacturer recommendations.
- .5 Install exterior receptacles located in landscaped grounds in accordance with drawing detail.
- .6 Where receptacles are indicated in counters and benches, box cut-out to be provided in counter and bench. Provide a box, receptacle, plate and branch circuit wiring. Branch circuit wiring within counters and benches to be flexible armoured cable, under requirements of local governing electrical code and standards. Install and connect complete.
- .7 Confirm final receptacle finishes with Consultant. Do not order any devices unless final finishes have been approved by Consultant.
- .8 Additionally, refer to testing and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

3.3 Installation of Faceplates

- .1 Provide each switch and receptacle with a faceplate with an opening or openings suitable for device it conceals and covers openings around boxes. Secure faceplates to device frames with screws to match faceplates. Provide larger than standard type faceplates for devices that require engraved nomenclature to define special purpose for that device.
- .2 Provide stainless steel faceplates for all interior wiring devices.
- .3 Provide galvanized stamped steel faceplates in service areas and equipment rooms where devices are surface mounted.
- .4 Provide weatherproof insulated faceplates with hinged and gasketed receptacle access flaps for weatherproof receptacles denoted "WP" on drawings.
- .5 Generally, oversized faceplates are to be provided where engraved lettering is required.

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- .6 Confirm exact material, finish, and colour of faceplates for devices in any particular area with Consultant prior to ordering.
- .7 Provide faceplates with printed clear self-adhesive label with black letters identifying circuit number and panel feeding device. Turn over label maker to Consultant prior to application for Certificate of Substantial Performance of the Work.

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Electric Vehicle Charging Stations

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PART 1 - GENERAL

1.1 References

- .1 The Society of Automotive Engineers:
 - .1 SAE J1772 - Electric Vehicle Conductive Charge Coupler
- .2 Underwriters Laboratories:
 - .1 UL 2594 - Standard for Electric Vehicle Supply Equipment
 - .2 UL 2231-1&2 - Standard for Personnel Protection Systems for Electric Vehicle Supply Circuits
 - .3 UL 1998 - Standard for Software in Programmable Components
 - .4 UL 991 - Standard for Tests for Safety-Related Controls Employing Solid-State Devices
- .3 Canadian Electrical Code:
 - .1 Section 86 - Electric Vehicle Charging Systems
- .4 LEED® Canada:
 - .1 NC 1.0, Credit 4.3, Alternative Transportation: Hybrid and Alternative Fuel Vehicles

1.2 Submittals

- .1 Submit Shop Drawings in accordance with Section 26
- .2 Submit Product Data Sheets for EV Charging Station. Include product characteristics and ratings, performance criteria, dimensions, limitations, compliance, listings and approvals, and installation details.
- .3 Manufacturer Instructions: Provide to indicate installation sequence, cleaning procedures and scheduled maintenance, etc.
- .4 User Manual: Include in O&M Manuals a comprehensive User Manual prepared for the general public explaining and illustrating the modes of operation, user instructions, safety precautions, DOs and DON'Ts and standard operating instructions.

PART 2 - PRODUCTS

2.1 EV Charging Station

- .1 The EV Charging Station shall be "ChargePoint" CT 4000 Family, cUL Certified, Dual Port, Level 2, free standing Bollard Mount or Wall Mount (as indicated) and comply with the applicable requirements of all Codes and Standards listed in Article 1.1 of this specification.
- .2 Enclosure Rating: NEMA 3R per UL 50E
- .3 Input Power Connections
 - .1 Power Sharing: Dual Port - One independent 40A branch circuits
- .4 Input Current: 30A Level 2

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- .5 Input Power Connections
 - .1 Staring Dual Port - 3-Wire (L1, L2 & Ground)
- .6 Required Service Panel Breaker:
 - .1 Power Sharing Dual Port - 1 x 40A 2-Pole (non-GFCI type)
- .7 Station Power: 8W typical (stand-by), 15W maximum (operational)
- .8 Output Charging Power
 - .1 Staring Dual Port - 2 x 7.2 kW (240VAC @ 30A) or 2 x 3.8kW (240V, 16A)
- .9 Functional Interfaces
 - .1 Connector Type & Charging Cable Length
 - .1 Dual Port - 2 x SAE J1772 - 5.5 meters (18')
 - .2 Overhead Cable Management System: Retractable system to keep charging cables off the ground
 - .3 Locking Holster: Electromechanically locks the SAE J1772 connector to the EV Charger between charging sessions.
 - .4 RFID Card Reader: ISO 15693 & 14443, NFC (for contactless credit cards)
 - .5 LCD Display: 5.7" full color, 640 x 480, 30 fps full motion video, active matrix, UV protected
- .10 Safety & Connectivity
 - .1 Ground Fault Protection: 20 mA CCID with auto retry
 - .2 Open Safety Ground Protection: Continuously monitors presence of ground connection
 - .3 Plug-Out Detection: Power terminated per SAE J1772™ specifications
 - .4 Power Measurement Accuracy: +/- 2% from 2% to full scale (32A)
 - .5 Power Report / Store Interval: 15 minute, aligned to hour
 - .6 Local Area Network: 2.4 GHz Wi-Fi (802.11b/g/n)
 - .7 Wide Area Network: 3G GSM, 3G CDMA
- .11 Safety & Operational Ratings
 - .1 Enclosure Rating: NEMA Type 3R per UL 50E
 - .2 Surge Protection: 6 kV at 3000A.
 - .3 EMC Compliance: FCC Part 15 Class A.
 - .4 Operating Temperature: -30°C to +50°C.
 - .5 Operating Humidity: Up to 85% @ +50°C non-condensing
 - .6 Non-Operating Humidity: Up to 95% @ +50°C non-condensing
 - .7 Terminal Block Temperature Rating: 105°C
 - .8 Maximum Charging Stations per 802.11 Radio Group: 10. Each station must be located within 45m (150') 'line-of-sight' of a Gateway Station

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- .12 Stations are to be ChargePoint® Network enabled that communicate with the ChargePoint® Network via cellular modem. Data lines are not required. Stations utilize the following functions:
 - .1 Remote Monitoring & Troubleshooting
 - .2 On-Line 'Station Manager' Software
 - .1 PCI Compliant Payment Collection and Processing
 - .2 Restricted Access, Access Control and Pricing
 - .3 Real-time reporting for each charging station
 - .3 Mobile Applications for iPhone®, Android® & Blackberry®
 - .4 Mobile Alert System
- .13 Commercial/Public Station Hardware features the following:
 - .1 Compact Design - Available in Bollard Mount or Wall Mount
 - .2 Segmented Construction - For fast & easy installation or repair
 - .3 Integrated RFID Smart Card Reader - Accepts ChargePass cards and/or contactless credit cards
 - .4 Custom Replaceable Signage: Templates supplied at owners request
 - .5 Utility Grade Energy Meter - Integrated power metering circuitry provides accurate bi-directional energy measurement.
 - .6 Integrated Fault Detection for Ground Fault and Over-Current Detection.
 - .1 Auto Re-Try and Driver Notification to ChargePass card users
 - .7 Network Interface: Wireless mesh and cellular network interfaces allow seamless integration with back office business systems or utility AMI's (Advanced Metering Infrastructure).
 - .8 Smart Grid Compatible: Utility grade meter and smart-grid interfaces to enable demand response and Time-Of-Use (TOU) pricing.
- .14 To be Leviton Evr-Green 4000 Series, Dual Port Level 2 (as indicated) or equal, meeting or exceeding the Leviton Evr-Green 4000 Series specifications.

PART 3 - EXECUTION

3.1 Installation

- .1 The Installation shall be performed by the Electrical Contractor
- .2 Provide concrete base (if required) and install the unit as per manufacturer instructions.
- .3 Connect the unit to branch circuit panel board as shown on drawings.
- .4 Start-up, test and activate the unit as per manufacturer instructions.
- .5 Provide a permanent sign to read ELECTRIC VEHICLE CHARGING STATION.

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3.2 Field Quality Control

- .1 The Activation 'Instructions & Worksheet' shall be provided by the Electrical Contractor or a Factory Certified Technician employed by either the manufacturer or a manufacturer certified company. Activation shall include one visit to perform all procedures, tests and verifications as specified by the manufacturer within the unit's installation, testing and verification manuals.
- .2 The following procedures and tests shall be performed during the activation process:
 - .1 Visual Inspection:
 - .1 All equipment for signs of damage or foreign materials as well as cleanliness of the installed system.
 - .2 All equipment for any other safety related matters.
 - .2 Mechanical Inspection:
 - .1 Check all power connections for tightness.
 - .2 Check all control wiring terminations and plugs for proper seating.
 - .3 EV Charging Station Tests: Demonstrate the functions to ensure;
 - .1 Proper functioning of the unit
 - .2 Proper operation of the driver notification.
- .3 Tests shall be performed during the substantial completion field review by the electrical field reviewer and witnessed by him or her if such witnessing is requested.
- .4 Notify persons witnessing at least 15 working days in advance of test date and time.
- .5 Arrange for facility's maintenance representative to be present during tests.
- .6 Operational Training: Before leaving the site, the Electrical Contractor or the Factory Certified Technician shall familiarize responsible personnel with the operation of the EV Charging Station. The training shall include at least one 1-hour session.

3.3 Warranty

- .1 The manufacturer warrants equipment to be free from defects in materials and workmanship for one year from date of installation or 18 months from purchase, whichever comes first.

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Secondary Switchboards

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for products specified in this Section.

1.2 Breakers

- .1 Breakers to be NEMA rated types, and for switchboards and distribution panelboards, breakers when frame sized 225 amperes and greater, to be provided with solid state adjustable trip units with long time, short time and instantaneous time (LSI) functions and time delays. Set trip units at ratings as per coordination study as required for proper coordination. Provide ground fault alarm and trip functions at breaker trip rating above 600A, as coordinated with results of coordination study and as confirmed with Consultant.
- .2 Size breakers as per drawings and/or schedules, but in absence of direction, size breakers to suit intended application, to suit coordination study requirements and in accordance with local governing electrical safety code.

PART 2 - PRODUCTS

2.1 Standard Switchboards

- .1 Eaton (Cutler-Hammer), "Pow-R-Line C", indoor, metal enclosed, standardized service entrance switchboard for use in a solidly grounded system with a short circuit capacity as scheduled. Switchboard is shown and scheduled on drawings and complies with latest editions of following:
 - .1 EEMAC Standard G8 2;
 - .2 CSA Standard CAN/CSA C22.2 No. 31;
 - .3 NEMA Standard *B-2;
 - .4 UL 891.
- .2 Switchboard conforms to local governing electrical authority requirements.
- .3 Structure:
 - .1 Switchboard consists of individual sections bolted together to form an enclosed, self-contained, self-supporting structure with necessary facilities for proper ventilation. Switchboard is front accessible type needing no access from rear. Each section is of modern welded construction, fabricated from sheet steel in accordance with EEMAC, NEMA and CSA requirements and reinforced wherever necessary to provide adequate strength. Front panels or doors are formed type, fabricated with cold rolled sheet steel. Unless otherwise required, rear, top and side panels are bolt-on and secured suitably to a channel type base. After fabrication, switchboard is factory cleaned and finished with ANSI grey enamel.

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- .2 Entire enclosure to be in accordance with NEMA 1 or NEMA 2 requirements with additional sprinkler proof requirements. Top of each cell to be complete with a "drip-shield" designed to shed water without dripping on cell. Ventilation louvres to be designed to prevent penetration of water spray from activated sprinklers, onto live components. Doors and component openings to be gasketed.
- .4 Future Cells:
 - .1 Where shown, provide bus terminations for future extensions and gasketed water-tight removable side panels to accommodate installation and connection of future cells.
- .5 Bus Bars:
 - .1 Main bus bars are constructed of top quality, 98% pure, rectangular copper bars, silver flashed or silver plated at joints with lap type joints bolted using high strength steel bolts and extra wide, extra thick washers to ensure maximum pressure and even current distribution at each joint. Bus and connections are designed so that maximum temperature rise in any part of switchboard will not exceed 65C° (117F°) over an ambient temperature of 40°C (104°F). Bus is properly isolated and designed to carry currents as required.
 - .2 Ground bus not less than 6 mm (1/4") x 50 mm (2") cross section area extending length of switchboard and is solidly bolted to steel framework. Ground bus is constructed of same material as main bus and is complete with suitable lugs for grounding connections outlined on drawings. Ground bus is rated for momentary current rating equal to or greater than that of apparatus in switchboard.
 - .3 Supply required bolts, nuts, and washers for field connection of bus joints between cells.
- .6 Control Wiring:
 - .1 Each cell to be complete with required control wiring and terminal blocks. Control wiring is type "SIS", minimum size No. 14, extra flexible wire with thermoplastic insulation. Neatly harness and suitably secure control wiring.
 - .2 Terminal blocks are of pressure type and complete with removable marking strips.
- .7 Switchboard Arrangement and Components:
 - .1 Switchboard cell arrangement and components are as detailed on drawings.
- .8 Metering:
 - .1 Power Xpert Meter 2000 series (PXM 2260) microprocessor based multifunction, power and energy meters with features as follows:
 - .1 accuracy of +/- 0.1% or better for volts and amps, and 0.2% for power and energy functions; meet accuracy requirements of IEC687 (class 0.2%) and ANSI C12.20 (Class 0.2%);

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- .2 provide per phase % THD (Total Harmonic Distortion) monitoring to the 40th order for voltage (reference to neutral only) and current , and provide Volts, Amps, kW, kVAR, PF, kVA, Frequency, kWh, kVAh, kVARh and 1 KYZ pulse output, on board meter limit exceeded alarms, and 512 Megabytes for data logging;
 - .3 include a three-line, bright red LED display;
 - .4 include serial communications: RS-485; of Modbus RTU, Modbus ASCII, DNP 3.0 protocols;
 - .5 include network communications: RJ-45 10/100 Base-T Ethernet Network port; Ethernet TCP/IP, Modbus TCP, BACnet/IP, SNMP v1 & v3 (Network), SMTP (email), HTTP, HTTPS, Atom Feed protocols;
 - .6 Historical trend logging for graphical viewing from an embedded WEB server;
 - .7 to be configured and viewed from the on-board web server without the need for external software;
 - .8 I/O expandability through option card slot.
- .9 Utility Metering Provisions:
- .1 Confirm with and coordinate local electrical utility requirements and provide as required.
 - .2 Metering cells for utility metering and current and potential transformers and associated fuses to suit utility requirements and respective applications. Supply CT's/PT'S to switchboard manufacturer, for factory installation into metering cells, and secondary to be connected to terminal blocks. Provide minimum 38 mm (1-1/2") diameter conduit stub in bottom of each metering cell for site extension of conduit to meters.
- .10 Current and Potential Transformers:
- .1 Potential transformers are of compartment type and incorporate current limiting fuses.
 - .2 Current transformers have ratios to suit application, a mechanical rating equal to momentary rating of circuit breakers, and insulated for full voltage rating of switchgear.
 - .3 Current and potential transformers for local governing electrical utility metering are supplied by local governing electrical utility and are shipped to switchboard manufacturer's factory for factory mounting and connection.
- .11 Main Breakers:
- .1 Series "C", frame type as scheduled and as required for application, sized as scheduled, fixed mounted, solid state moulded case circuit breaker with adjustable trip unit as specified in Part 1. Provide minimum interrupting capacity as scheduled.

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- .2 Breakers to be complete with "Digitrip-310" RMS sensing solid state trip unit having the following adjustable tripping functions: long time pick-up, long time delay; short time pick-up; short time delay; instantaneous pick-up; ground fault pick-up; and ground fault delay. Trip settings to be as determined by distribution system testing and coordination study. Tripping unit to have three (3) sensors, one (1) on each phase conductor, arranged such that a trip signal from any sensor opens all three (3) poles of breaker.
- .3 Breaker to be ULC listed for application of 100% of its trip setting and is to be capable of carrying its full rated ampere capacity, indefinitely without tripping.
- .12 Circuit Breaker Distribution Section:
 - .1 Circuit breaker distribution section consists of Series "C" moulded case, bolt on circuit breakers with an interrupting capacity as scheduled and frame size to suit application. Refer to Part 1 for requirements of breakers to be provided with solid state adjustable trip units.
- .13 Surge Protective Devices (SPD):
 - .1 Switchboards to be complete with integral SPD unit installed in dedicated cell. Unit to be factory installed and connected onto bussing through integral disconnect as recommended by manufacturer. Unit to include diagnostic package with status indicators on each phase, LCD surge counter display, audible alarm with silence button and Form C alarm contacts. Unit to be maintenance free. Additional features include following:
 - .1 Type 1;
 - .2 In accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;
 - .3 Maximum voltage protection rating to not exceed 700 V (120/208 V) or 1500 V (600/347V); (L-N, L-G, N-G);
 - .4 Minimum nominal discharge current rating of 10 kA;
 - .5 Minimum short circuit current rating of 100 kA;
 - .6 Peak surge current 250 KA per phase;
 - .7 High-performance EMI/RFI noise rejection filter;
 - .8 Standard manufacturer's minimum 5 years parts and labour warranty;
 - .9 Flush mounting onto switchboard enclosure.
- .14 Incoming and Outgoing Conductor Connection Facilities:
 - .1 Provide required facilities and hardware including cubicle for incoming feeder, and outgoing cable in conduit feeders as shown and scheduled.
- .15 Mimic Bus and Nameplates:
 - .1 Red, single line vinyl bus approximately 3 mm (1/8") thick x 9 mm (3/8") wide, representing internal bussing and components, riveted to front of switchboard and extending through handles of respective breakers; engraved Lamacoid nameplates to be secured with stainless steel screws, adjacent each panel component and identifying each component.
 - .2 Finish colours, sizes, and nomenclature to be confirmed with Consultant.

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- .16 Accessories:
 - .1 Manufacturer's standard accessories, spare parts and maintenance tool kit.
 - .2 Manufacturer's installation drawings.
- .17 Testing, Start-up, Verification and Training:
 - .1 Assist installing Contractor in installation of equipment and to inspect installation, test equipment, perform start-up and verify equipment. Coordinate work with Contractor.
 - .2 Be present to assist during third party testing.
 - .3 Perform testing at times coordinated with Consultant.
 - .4 Provide instructions on system operating and maintenance.
- .18 Acceptable Manufacturers:
 - .1 Eaton (Cutler-Hammer);
 - .2 Schneider Electric (Square D);
 - .3 Siemens Electric Ltd.

PART 3 - EXECUTION

3.1 Installation of Switchboards

- .1 Provide switchboards and locate into positions. Base layout, design, connections and requirements for supplied accessories from documents and reviewed shop drawings. Carefully examine drawings and site conditions to ensure that equipment can be positioned into their designated positions, without difficulty. Ensure adequate clearance is provided as per code requirements and as required for access for operation and maintenance.
- .2 Coordinate cable entry location to match incoming conductors. Allow sufficient space for required cable bending radii and connections.
- .3 Assemble individual sections of switchboard in accordance with manufacturer's recommendations and instructions, and secure assembly to concrete base. Ensure that bus joint bolts are torqued to manufacturer's prescriptions.
- .4 Provide seismic restraints as required by local governing authorities and codes.
- .5 Coordinate delivery and installation of local electrical utility supplied metering transformers.
- .6 Arrange for switchboard manufacturer to provide necessary drawings for erection and installation of switchboard. In addition, if required, obtain from manufacturer necessary copies of detail, erection, etc., drawings required for approval of installation from local electrical utility and any other authority having jurisdiction. Obtain required approvals.
- .7 Install controls and displays at height of between a minimum 1200 mm (4') to a maximum of 1800 mm (6') above finished floor level.

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- .8 Provide alarm/communications circuits as required. Include for provision of conduits, boxes and control/signal wiring for interconnection to BAS. Coordinate with Mechanical Divisions BAS Contractor on location of BAS panel to be used for monitoring points and extend wiring in conduit from electrical equipment to location. Terminate in junction box leaving 3 m (10') of slack length of wiring (exact length to be coordinated between Mechanical and Electrical trades), for extending and termination to BAS panel by Mechanical Division BAS Contractor. Properly identify wiring and junction box.
 - .9 Ground and bond equipment to ground electrode grids as per local governing electrical code and inspection authority requirements. Refer also requirements of grounding and bonding article.
 - .10 Install and test SPD as per manufacturer's instructions.
 - .11 Test remote alarms.
 - .12 Test key operator locks and sequence of operation.
 - .13 Arrange switchboard in configuration as indicated on drawings and as per reviewed shop drawings.
 - .14 Make necessary incoming and outgoing power cable connections to equipment in strict accordance with equipment and cable manufacturer's recommendations. Ensure connections, bus flanges and terminations are suitable for specific incoming and outgoing cables/bus ducts.
 - .15 Arrange for switchgear manufacturer's personnel to provide inspection and testing of switchboard prior to energizing system.
 - .16 Provide engraved Lamacoid nameplates with nomenclature confirmed with Consultant.
 - .17 Additionally, refer to testing, coordination and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

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Distribution Panelboards

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for products specified in this Section.

PART 2 - PRODUCTS

2.1 Distribution Panelboards

- .1 Eaton (Cutler-Hammer), "Pow-R-Line" series factory assembled dead front panelboards as per drawing schedules, manufactured to CSA Standard C22.2. No. 29. Generally, interrupting capacities are scheduled, but in absence of direction, provide to capacity to suit intended application to suit local governing electrical code.
- .2 Circuit breaker type "PRL4B" distribution panelboards to be single or double row as required and complete with moulded case, bolt-on circuit breakers calibrated for 40°C (104°F) ambient temperature and conforming to CSA Standard C22.2 No. 5 (Note No. 1). Locate both main lugs and neutral bar at same end. Shield main lugs through a removable cover. Identify each circuit breaker adjacent breaker handle. Refer to Part 1 for requirements of breakers to be provided with solid-state adjustable trip units. Group mount circuit breakers.
- .3 Switch and fuse type "PRL4F" distribution panelboards, complete with quick-make, quick-break, visible contact load break switches with operating handles projecting through dead front panel and interlocked with switch mechanism, facilities for padlocking in either ON or OFF position, and, unless otherwise noted, HRC Form I, Class "J" fuses.
- .4 Distribution panelboards of rating greater than 1200 amperes rating to be series "Pow-R-Line C" switchboard types as specified in Section titled Secondary Switchboards.
- .5 Panelboard interior to have three flat bus bars stacked and aligned vertically with insulators laminated between phases. Insulators support and provide phase isolation to entire length of bus. A solidly bonded equipment ground bar and a neutral bar to be provided.
- .6 Bus bars (phases, grounds and neutrals) to be hard drawn electrical grade copper, silver plated and extend throughout panel.
- .7 Interior trim to be of dead-front construction to shield user from energized parts. Main circuit breaker and main lug interiors to be field convertible for top or bottom incoming feed.
- .8 Panelboard boxes to be constructed of code gauge, hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements, complete with removable ends and wiring gutter space on sides in accordance with CSA requirements.
- .9 Floor mounted enclosures to be free-standing type, reinforced as required to provide adequate strength.
- .10 Include main breakers for panelboards as scheduled. Main breakers to be automatic moulded case breakers with solid state trip units as specified in Part 1 article.

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- .11 Enclosures located in climate controlled areas to be minimum NEMA 1. Surface mounted panelboards to be complete with drip shield. Ventilation louvres to be designed to prevent penetration of water spray onto live components. Conduit entries to be sealed watertight. Units to be factory painted in ANSI grey enamel. Recessed backboxes (tubs) need not be finished painted.
- .12 Distribution panelboards sized 600A and less and panelboards not located in secured electrical rooms/closets require doors. Panelboards sized up to 600A and panelboards located in unsecure areas to be complete with doors, latches, and keyed alike locks. Locks to be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. Supply 2 keys with each lock.
- .13 Panelboards to include for future breaker provisions as noted on schedules. Make provision for space for breakers, bussing for full panel size and where spare breakers are scheduled, breakers with required connector kits. Unused spaces provided, unless otherwise specified, to be fully equipped for future devices, including appropriate connectors and mounting hardware.
- .14 Panelboards as scheduled to be complete with integral surge protective devices (SPDs). Unit to be factory installed and connected onto bussing through integral disconnect/breaker as recommended by manufacturer. Unit to include diagnostic package with status indicators on each phase, audible alarm and Form C alarm contacts. Unit to be maintenance free. SPD features include:
 - .1 Type 1;
 - .2 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;
 - .3 maximum voltage protection rating to not exceed 700 V (120/208 V) (L-N, L-G, N-G);
 - .4 minimum nominal discharge current rating of 10 kA;
 - .5 minimum short circuit current rating of 100 kA;
 - .6 peak surge current 150 KA per phase;
 - .7 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of panelboard;
 - .8 high-performance EMI/RFI noise rejection filter;
 - .9 standard manufacturer's minimum 5 years parts and labour warranty.
- .15 Acceptable manufacturers are:
 - .1 Eaton (Cutler-Hammer);
 - .2 Schneider Electric (I-Line Series);
 - .3 Siemens Electric Ltd.

PART 3 - EXECUTION

3.1 Installation of Distribution Panelboards

- .1 Provide distribution panelboards and install into locations and connect complete. Ensure adequate clearance is provided as per code requirements and as required for access for operation and maintenance.

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- .2 Install floor mounted panelboards on concrete housekeeping pads. Provide seismic restraints as required by local governing authorities and codes. Surface wall mount other panelboards, unless otherwise noted, independent of connecting conduit.
 - .3 Equip each panelboard with suitable lugs to accommodate main and branch conductors as scheduled. Identify panelboard and breakers with Lamacoid identification nameplate with nomenclature to Consultant's approval.
 - .4 Connect SPD in accordance with Manufacturer instructions and with dedicated breaker.
 - .5 Ground and bond equipment as per local governing electrical code and inspection authority requirements. Refer also to requirements of grounding and bonding article.
 - .6 Additionally, refer to testing, coordination and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for products specified in this Section.

PART 2 - PRODUCTS

2.1 Branch Circuit Panelboards

- .1 Eaton (Cutler-Hammer), "Pow-R-Line" series, factory assembled dead front panelboards as per schedules, manufactured to CSA Standard C22.2 No. 29 and local governing electrical code, and designed for sequence phase connection of branch circuit breakers.
- .2 As scheduled, panelboards are of types:
 - .1 "Pow-R-Line 1", 120/208 V, 3-phase and single phase with minimum "BAB" frame, bolt-on moulded case circuit breakers with a minimum interrupting capacity of 10 kA symmetrical at 208 V, unless otherwise scheduled. Where panelboards are schedule to include series rated provisions, provide breakers as recommended by panel manufacturer;
 - .2 "Pow-R-Line 2" 347/600 V, 3-phase panelboards with minimum "GBH" frame, bolt-on moulded case circuit breakers with an interrupting capacity as scheduled or in absence of direction to be of capacity for intended application to local governing electrical code requirements.
- .3 Where ground fault circuit interrupting (GFCI) type breakers are required by code and/or scheduled, provide "Quicklag" ground fault, CSA Class "A", Group 1, combination thermal magnetic bolt-on circuit breakers with solid-state ground fault interrupters.
- .4 Panelboards to be equipped with one (1) continuous bus bar per phase. Each bus bar to have sequentially phased branch circuit connectors limited to bolt-on branch circuit breakers. Bussing to be fully rated and of plated copper construction.
- .5 Panelboards are to be complete with:
 - .1 NEMA 1, box constructed of code gauge galvanized steel with removable box ends, wiring gutter space on sides; conduit entries sealed water-tight;
 - .2 dead-front construction to shield user from energized parts;
 - .3 enclosure constructed of code gauge, hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements; trim for flush or surface wall mounting as shown; front panel to not be removable with the door locked;
 - .4 hinged door with concealed fasteners, concealed hinge, chrome plated door latch and keyed alike lock with key;
 - .5 a steel frame holder and circuit directory card protected by clear acetate and secured to back of door, and Mylar circuit breaker identification strips;
 - .6 drip shield for surface mounted panelboards;
 - .7 copper neutral bars;
 - .8 solidly bonded equipment copper ground bar;
 - .9 high strength, set screw type, anti-turning wire connectors;

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- .10 current-carrying parts be insulated from ground and phase-to-phase by high dielectric strength thermoplastic;
- .11 isolated ground bus for panelboards feeding electrically sensitive equipment;
- .12 filler plates covering unused mounting space;
- .13 non-automatic and automatic main breaker to function as an isolating switch, where shown and as required;
- .14 ground fault circuit interrupting (GFCI) type breakers to feed devices as scheduled and for applications required by local governing codes;
- .15 arc fault circuit interrupter (AFCI) type breakers to feed devices as scheduled and for applications required by local governing codes.
- .6 Panels, doors and trim are to be factory painted with ANSI grey enamel finish. Recessed backboxes (tubs) need not be finished painted.
- .7 Equip breakers of frame size 225 amperes and greater, with solid state adjustable trip units.
- .8 Equip circuit breakers connected to dedicated equipment or devices with handle locks.
- .9 Panelboards as scheduled to be complete with integral surge protective devices (SPDs). Unit to be factory installed and connected onto bussing through integral disconnect/breaker as recommended by manufacturer. Unit to include diagnostic package with status indicators on each phase, audible alarm and Form C alarm contacts. Unit to be maintenance free. SPD features include:
 - .1 Type 1;
 - .2 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;
 - .3 maximum voltage protection rating to not exceed 700 V (120/208 V) (L-N, L-G, N-G);
 - .4 minimum nominal discharge current rating of 10 kA;
 - .5 minimum short circuit current rating of 100 kA;
 - .6 peak surge current 100 kA per phase;
 - .7 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of panelboard;
 - .8 high-performance EMI/RFI noise rejection filter;
 - .9 standard manufacturer's minimum 5 years parts and labour warranty.
- .10 Include spare breakers as sized on schedules and future breaker provisions as noted on schedules. Future breaker provisions to include space for breakers, bussing for full panel size and where future breaker sizes are scheduled, required breaker connector kits.
- .11 In addition to these requirements and scheduled load breakers, each normal power panelboard to include provisions for small power for miscellaneous mechanical loads, consisting of an additional quantity of five (5) 15A-1p breakers, each installed and each connected to 30 m (100') 2-No. 12 plus ground in 13 mm (1/2") EMT conduit branch circuit feeders, with termination to various mechanical loads to be determined at time of construction.
- .12 Unless otherwise scheduled or noted, include a of minimum three (3) 15A-1P breakers to feed BAS panels.

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- .13 Acceptable manufacturers are:
 - .1 Eaton (Cutler-Hammer);
 - .2 Schneider Electric (Square D);
 - .3 Siemens Electric Ltd.

2.2 Load Centres

- .1 Eaton (Cutler-Hammer), CSA approved, type BR load centres as follows:
 - .1 NEMA 1 enclosure manufactured from cold rolled 16 gauge steel and complete with ANSI grey enamel finish;
 - .2 front panel with hinge door and locking operator; front cover with trim to mount flush with wall onto recessed enclosure;
 - .3 single phase, 3-wire, 120/240 VAC; 10 kA IC;
 - .4 copper bussing and bars;
 - .5 main non-automatic breaker;
 - .6 plug in type BR series breakers;
 - .7 100 Amp main bussing rating;
 - .8 minimum sized to accommodate at least 20 breakers;
 - .9 Type BR-AFCI arc fault circuit interrupting type breakers to feed devices as scheduled and as required by local governing codes;
 - .10 Type BR-GFCI ground fault circuit interrupting type to feed devices as scheduled and as required by local governing codes;
 - .11 twin neutral with insulated cross strap for bonding applications as required by Code;
 - .12 drip shield for surface mounted panels;
 - .13 typed circuit directing card.
- .2 Acceptable manufacturers are:
 - .1 Eaton (Cutler-Hammer);
 - .2 Schneider Electric (Square D);
 - .3 Siemens Electric Ltd.

2.3 Enclosed Circuit Breakers

- .1 Eaton (Cutler-Hammer), moulded case, front operated, surface mounted, non-automatic circuit breakers sized on drawings, each secured in NEMA 3R wall mounting enclosure with steel front panel and arranged so that circuit breaker can be padlocked in OFF position. Cover interlocked such that cover cannot be opened if breaker is in ON position.
- .2 Eaton (Cutler-Hammer), moulded case, front operated, flush mounted, non-automatic circuit breakers sized on drawings, each secured in NEMA 1 wall mounting enclosure with steel front panel and arranged so that circuit breaker can be padlocked in OFF position. Cover interlocked such that cover cannot be opened if breaker is in ON position.

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- .3 Eaton (Cutler-Hammer), moulded case, front operated, surface mounted, automatic circuit breakers sized on drawings, each secured in NEMA 3R wall mounting enclosure with steel front panel and arranged so that circuit breaker can be padlocked in OFF position. Cover interlocked such that cover cannot be opened if breaker is in ON position.
- .4 Eaton (Cutler-Hammer), moulded case, front operated, flush mounted, automatic circuit breakers sized on drawings, each secured in NEMA 1 wall mounting enclosure with steel front panel and arranged so that circuit breaker can be padlocked in OFF position. Cover interlocked such that cover cannot be opened if breaker is in ON position.
- .5 Acceptable manufacturers are:
 - .1 Eaton (Cutler-Hammer);
 - .2 Schneider Electric (Square D);
 - .3 Siemens Electric Ltd.

PART 3 - EXECUTION

3.1 Installation of Panelboards

- .1 Provide factory assembled branch circuit panelboards and install into locations and connect complete. Ensure adequate clearance is provided as per code requirements and as required for access for operation and maintenance. Load panels with breakers as scheduled.
- .2 Support cabinets and enclosures independent of connecting conduit, and accurately install with reference to wall finishes.
- .3 Equip panelboards with suitable lugs or provisions to accommodate main and branch conductors scheduled.
- .4 Coordinate with Mechanical Division trades and Consultant to determine extra mechanical loads and BAS panels requiring use of specified additional 15A circuits and connect complete.
- .5 Ground and bond equipment as per local governing electrical code and inspection authority requirements. Refer also to the requirements of Section titled Grounding and Bonding.
- .6 Turn over to Consultant, prior to application for a Certificate of Substantial Performance of Work, a quantity of two (2) panelboard cabinet or enclosure keys per panelboard.
- .7 Where two (2) or more panelboards are installed in one (1) cabinet, equip panelboards with double lugs and increase gutter capacity to accommodate additional cabling.
- .8 Identify panelboard breakers in a permanent manner, and complete typed panelboard circuit directories identifying circuit number and type and location of loads supplied from each breaker to Consultant's approval.
- .9 Include for spaces for future breakers, spare breakers and additional breakers for miscellaneous mechanical loads are included as per schedules and as specified.
- .10 Install and connect SPD in accordance with Manufacturer instructions and with dedicated breaker. Test SPD as per Manufacturer instructions.

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- .11 Test and verify ground fault circuit interrupting breakers as follows:
 - .1 demonstrate in presence of Consultant that protected circuits will "trip" when a simulated ground fault is applied to "load" side of each circuit breaker/ground fault interrupter combination;
 - .2 megger load side neutral on GFCI protected branch circuits to ensure that neutral is not grounded on load side of GFCI;
 - .3 verify GFCI operation with a temporary load (100 watt lamp in an insulated socket with pigtail leads);
 - .4 provide a written report confirming that tests have been performed and that system is functioning properly.
- .12 Ground and bond panel as per local electrical code requirements. Refer also to requirements of grounding and bonding article.
- .13 Additionally, refer to testing, coordination and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

3.2 Installation of Load Centres

- .1 Provide factory assembled load centres and connect complete. Ensure adequate clearance is provided as per code requirements and as required for access for operation and maintenance. Load panels with breakers as scheduled.
- .2 Support enclosures independent of connecting conduit, and accurately install with reference to wall finishes.
- .3 Equip enclosures with suitable lugs or provisions to accommodate main and branch conductors scheduled.
- .4 Identify breakers in a permanent manner, and complete typed panelboard circuit directories identifying circuit number and type and location of loads supplied from each breaker to Consultant's approval.
- .5 Include for spaces for future breakers and spare breakers as per schedules.
- .6 Test and verify ground fault interrupting breakers as follows:
 - .1 demonstrate in presence of Consultant that protected circuits will "trip" when a simulated ground fault is applied to "load";
 - .2 side of each circuit breaker/ground fault interrupter combination;
 - .3 megger load side neutral on GFI protected branch circuits to ensure that neutral is not grounded on load side of GFI;
 - .4 verify GFI operation with a temporary load (100 watt lamp in an insulated socket with pigtail leads);
 - .5 provide a written report confirming that tests have been performed and that system is functioning properly.
- .7 Ground and bond panel as per local electrical code requirements. Refer also to requirements of grounding and bonding article.
- .8 Additionally, refer to testing, coordination and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

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3.3 Installation of Enclosed Circuit Breakers

- .1 Provide wall mounted enclosed, circuit breakers for equipment. Include required accessories. Secure to wall construction and connect complete.
- .2 Confirm exact locations prior to roughing-in.
- .3 Ground and bond equipment as per local governing electrical code and inspection authority requirements. Refer also to requirements of grounding and bonding article.
- .4 Provide a lamacoid identification nameplate for each enclosure. Confirm exact nomenclature with Consultant prior to manufacturer.
- .5 Additionally, refer to testing, coordination and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

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Surge Protective Devices

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for products specified in this Section.

PART 2 - PRODUCTS

2.1 Surge Protective Devices

- .1 Switchboards to be complete with either external or integral surge protective devices (SPDs). If external, unit to be connected onto bussing through dedicated breaker as recommended by manufacturer. If integral, unit to be factory installed into separate cubicle section and connected onto bussing through integral disconnect as recommended by manufacturer. SPD features include following:
 - .1 In accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;
 - .2 Type 1;
 - .3 maximum voltage protection rating to not exceed 700V (120/208V) or 1500V (600/347V); (L-N, L-G, N-G);
 - .4 minimum nominal discharge current rating of 10 kA;
 - .5 minimum short circuit current rating of 100 kA;
 - .6 peak surge current 250 kA per phase;
 - .7 high-performance EMI/RFI noise rejection filter;
 - .8 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of switchgear/switchboard;
 - .9 diagnostic package with status indicators on each phase;
 - .10 LCD surge counter display;
 - .11 audible alarm with silence button;
 - .12 Form C alarm contacts;
 - .13 maintenance free and not require any user intervention throughout its life;
 - .14 standard manufacturer's minimum 5 years parts and labour warranty.
- .2 Distribution panelboards as scheduled to be complete with either external or integral surge protective devices (SPDs). If external, unit to be connected onto bussing through dedicated breaker as recommended by manufacturer. If integral, unit to be factory installed and connected onto bussing through integral disconnect/breaker as recommended by manufacturer. SPD features include:
 - .1 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;
 - .2 Type 1;
 - .3 maximum voltage protection rating to not exceed 700 V (120/208 V) (L-N, L-G, N-G);
 - .4 minimum nominal discharge current rating of 10 kA;

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- .5 minimum short circuit current rating of 100 kA;
 - .6 peak surge current 150 kA per phase;
 - .7 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of panelboard;
 - .8 high-performance EMI/RFI noise rejection filter;
 - .9 indicator LED on units to identify protection integrity status of MOVs; indicator to be visible on front of switchgear/switchboard;
 - .10 diagnostic package with status indicators on each phase;
 - .11 audible alarm;
 - .12 Form C alarm contacts;
 - .13 maintenance free and not require any user intervention throughout its life;
 - .14 standard Manufacturer minimum 5 years parts and labour warranty.
- .3 Branch circuit panelboards as scheduled to be complete with either external or integral surge protective devices (SPDs). If external, unit to be connected onto bussing through dedicated breaker as recommended by manufacturer. If integral, unit to be factory installed and connected onto bussing through integral disconnect/breaker as recommended by manufacturer. SPD features include:
- .1 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;
 - .2 Type 1;
 - .3 maximum voltage protection rating to not exceed 700V (120/208V) (L-N, L-G, N-G);
 - .4 minimum nominal discharge current rating of 10 kA;
 - .5 minimum short circuit current rating of 100 kA;
 - .6 minimum peak surge current 100 kA per phase;
 - .7 high-performance EMI/RFI noise rejection filter;
 - .8 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of panelboards;
 - .9 diagnostic package with status indicators on each phase;
 - .10 audible alarm;
 - .11 Form C alarm contacts;
 - .12 maintenance free and not require any user intervention throughout its life;
 - .13 standard Manufacturer minimum 5 years parts and labour warranty.

2.2 Acceptable Manufacturers

- .1 Acceptable manufacturers are:
 - .1 Eaton (Cutler-Hammer);
 - .2 Schneider Electric;
 - .3 Siemens Electric Ltd;
 - .4 APT (Advanced Protection Technologies).

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PART 3 - EXECUTION

3.1 Installation of SPD Units

- .1 Obtain required training from Manufacturer representative on any special installation procedures. Install units in accordance with Manufacturer instructions to suit specific installation requirements.
- .2 Coordinate switchgear / switchboard configuration to accommodate dedicated cell to install SPD units for applications of integral mounting. Install dedicated disconnect/breaker device of type and rating in accordance with SPD manufacturer requirements. Connect complete to SPD and bussing.
- .3 Mount SPD units adjacent to switchgear/switchboards or panelboards such that connecting conductors to dedicated breaker are of length not exceeding SPD manufacturer requirements.
- .4 Ensure that MOV condition LED indicator is visible from front of board/panel.
- .5 Connect and make necessary incoming and outgoing power cable connections to equipment in strict accordance with equipment manufacturer recommendations.
- .6 Ground and bond components as per local electrical code requirements. Refer also to requirements of grounding and bonding article.
- .7 Manufacturer representative to assist installing Contractor in installation of equipment, testing equipment, performing start-up and verification of equipment.
- .8 Be present to assist during third party testing.
- .9 Perform testing at times coordinated with Consultant.
- .10 Provide instructions on system operating and maintenance.
- .11 Additionally, refer to testing, coordination and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for products of this Section, and on Schedule of Luminaires on drawings.
- .2 Include photometric data, lamp, and ballast information for each luminaire. Include ballast data identifying maximum circuit loading limitations.
- .3 Photometric data to include: total input watts, candlepower summary, candela distribution zonal lumen summary, luminaire efficiency, CIE type, coefficient of utilization, lamp type and lumen rating in accordance with IESNA testing procedures.
- .4 Include copy of certification that lenses and louvers comply with local governing building code requirements for flame spread ratings.
- .5 For exterior site areas or parking areas, where luminaires are proposed that are not from based specified manufacturer, provide luminaire Manufacturer computer prepared detailed photometric layout drawings with complete photometry showing performance levels of proposed luminaires. Clearly identify lighting levels, quantity, locations, mounting heights, etc. Identify variances from base design.

1.2 Warranty

- .1 Warranty requirements are as follows:
 - .1 unless otherwise noted, LED and LED drivers for a period of five (5) years from date of acceptance of Work by Owner for its intended use;
 - .2 include costs for personnel, equipment and labour for replacing LED and drivers covered under warranty;

1.3 Substitutions

- .1 Provide luminaires as specified in Schedule of Luminaires and as per documented List of Manufacturers, where applicable. During construction period, no substitutions are permitted unless compelling reasons are given and accepted by Owner and Consultant. A delay caused by Contractor's failure to order luminaires to meet construction schedule is not a valid reason.
- .2 Make requests for proposed substitutions as per requirements of Section titled Electrical Work General Instructions and Division 01.
- .3 Consideration of any proposed substitutions after Bid Period to be at Consultant's sole discretion.

PART 2 - PRODUCTS

2.1 Luminaires

- .1 Provide luminaires in accordance with Schedule of Luminaires found on drawings. Luminaires are to be CSA approved or have special local electrical authority approval.

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- .2 Provide thickness of metal as indicated in Schedule of Luminaires and details, or as required so that luminaires are rigid, stable and resists deflection, twisting, warping or bending under normal installation procedures, re-lamping etc., or no less than requirements specified herein the specifications.
- .3 Unless otherwise noted, linear and continuous linear architectural LED luminaires bodies to be constructed of extruded aluminum and of rigid construction. Unless otherwise noted, provide body finishes of corrosion resistant, chemically treated and electrostatically applied post powder coat finish. Efficiency not to be less than 69%.
- .4 Unless otherwise noted, vandal resistant luminaires to be constructed of heavy duty extruded aluminum rails and die cast end caps, complete with stainless steel Torx with centre reject pin and Allen head set screws. Screw heads to be mounted and concealed under lens. Lens to be extruded UV stabilized polycarbonate lens with internal linear ribbed design.
- .5 Provide neoprene or silicone gasketting, barriers and stops where required to prevent light leaks or water/water vapour penetration.
- .6 Fabricate housings to allow for easy accessibility and replacement of parts.
- .7 Fabricate fixtures with a minimum number of joints. Make unexposed joints by acceptable method such as welding, brazing, screwing or bolting. Soldered joints are unacceptable. Do not use blind metal tapping methods or rivets for fastening parts which must be removed during service, or for fastening electrical components and supports. Cast parts, including die-cast members, to be of uniform quality, close grained, rigid, true to pattern, free from blow holes, pores, discoloration, hard spots, shrinkage defects, and cracks or other imperfections that affect strength and appearance or are indicative of inferior metals or alloys.
- .8 Reflectors and reflecting cones or baffles to be free of any tooling marks, spinning lines or marks by other assembly techniques. For fluorescent sources, iridescence to be low. Finishes to be equal to first quality polished, baffled, and anodized "Alzak".
- .9 Lenses and louvres to comply with local governing building code and other local governing code flame spread rating requirements.
- .10 Unless otherwise noted, construct acrylic lens from 100% virgin acrylic and not less than 3.22 mm (0.125") thick. Fluorescent K12 acrylic lenses to have recessed prismatic pattern with no fade-outs or streaks and be of strain-free and uniform production. Glass lenses to be minimum 9.5 mm (0.375") thick.
- .11 Luminaires to be factory assembled and tested prior to delivery on site.
- .12 Exposed parts and hardware of luminaires located in non-climate controlled areas to be corrosion resistant and weather resistant. Hardware to be tamper-proof. Manufacturer exterior luminaire poles with corrosion resistant finish and construction. Pole suppliers to ensure that poles supplied are suitable for steady wind velocity and gust velocity of area of installation, and suitable for total effective projected area of lighting equipment. Submit verification of this with shop drawings.
- .13 When requested, submit luminaire samples.
- .14 Dimensions for coves, valances, and strips as shown on drawings are for bidding purposes only. Job measure for exact dimensions of louvres, lenses and strips.

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- .15 Dimensions for linear and continuous linear LED as shown on drawings are for bidding purposes only. Job measure for exact dimensions requirements to suit installation location.
- .16 Confirm exact colours and finishes of luminaires with Consultant after award of contract but prior to ordering. Obtain information in time to meet installation schedule.
- .17 Comply with local governing building code requirements with regards to tandem wired connection of fluorescent luminaires and ballasts to eliminate unnecessary use of single lamp ballasts.
- .18 Coordinate with ballast manufacturers and dimmer/occupancy control manufacturers to ensure that components are compatible with each other and that interconnections do not affect performance, life or any warranties.
- .19 Products of same specified type to be of same manufacturer.
- .20 Acceptable Luminaires Manufacturer/Supplier.
 - .1 GS Lighting Group
 - .2 Medgar Lighting
 - .3 Salex SW
 - .4 WSC Lighting Systems

2.2 LEDS & Drivers

- .1 General features include:
 - .1 CSA approved, ULC listed and labelled;
 - .2 Operating temperature:
 - .1 Luminaires for applications in non-climate controlled area: operating temperature range through -40°C (-40°F) to 60°C (140°F);
 - .2 Luminaires for applications in climate controlled area: operating temperature range through -20°C (-4°F) to 50°C (122°F);
 - .3 With rapid and changing development of LED technology, provide most technically proven and most advanced and successfully tested LED technology at time of installation;
 - .4 Specification standards to meet requirements of IES LM 79 and LM-80.
 - .5 Be 100% compatible with connected dimmer controls to provide dimming down to 5%.
- .2 Light emitting diodes (LEDs) features to include:
 - .1 LEDs to be selected from same colour bin size for consistency in chromaticity and meet ANSI C78 377A as a minimum;
 - .2 generally, colour temperature range to be from 2700 K to 6500 K; specific temperature requirements to be identified on Schedule of Luminaires;
 - .3 minimum CRI of 80 ;
 - .4 rated life (based on 70% lumen depreciation level) from 50,000 to 70,000 hours.
- .3 Driver (ballast) features to include:
 - .1 Operate from 60 Hz input source of 120 VAC with sustained variations of $\pm 10\%$ (voltage and frequency) with no damage to driver;

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- .2 Output regulated to $\pm 5\%$ across load range;
 - .3 Power factor greater than 0.90;
 - .4 Total harmonic distortion less than 20%;
 - .5 Class A sound rating;
 - .6 Comply with ANSI C62.41 Category A for transient protection.
- .4 Acceptable manufacturers to be as recommended by luminaire manufacturers.

PART 3 - EXECUTION

3.1 Installation

- .1 Provide luminaires as required. Obtain required training from manufacturer representative on any special installation procedures. Install products in accordance with manufacturer instructions to suit specific installation requirements.
- .2 Before placing luminaire orders:
 - .1 verify quantity requirements;
 - .2 thoroughly review ceiling types, finishes and construction details; verify ceiling types with latest Architectural Drawings; order luminaires to suit correct ceiling type;
 - .3 ensure that required mounting assemblies, frames, rings and similar features are included;
 - .4 confirm colours and finishes with Consultant.
- .3 Include for assembly and mounting of luminaires and lamps, complete with:
 - .1 wiring and connections;
 - .2 fittings and hangers;
 - .3 aligners;
 - .4 box covers;
 - .5 other accessories required for a complete, safe and fully operational assembly.
- .4 Where outlet boxes locations are shown on drawings, they are diagrammatic only. Position outlet boxes to coincide with suspension hangers and knockouts.
- .5 Install ceiling fixtures in centre of tiles unless dimensioned otherwise on Reflected Ceiling Plans. Locate hangers on tile centres or intersections. Mount recessed downlights, troffers, and surface mounted luminaires in or on full tiles. Install fixtures in and on acoustical tile ceilings in alignment with tile joints.
- .6 Cut holes for recessed luminaires to exact size so that gaps are not visible or luminaire trims cover gaps.
- .7 Mount surface ceiling luminaires perfectly level or plumb, tightly to ceiling without showing a space or light leak between frame and ceiling.
- .8 Carefully align linear luminaires shown in continuous lines or rows, so that rows appear as straight lines. Variation in alignment not to exceed 6 mm (1/4") for any 5 m (16') run.
- .9 Provide spacers for fixtures mounted on low density ceiling material.
- .10 Provide plaster frames for recessed fixtures in plaster or gypsum board ceilings.

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- .11 Prepare fixtures, trim and poles and standards required to be painted.
- .12 Wiring between fluorescent lamp holders and associated operating and starting equipment to be of similar or heavier gauge than leads furnished with approved types of ballasts with equal or better insulating and heat-resistant characteristics.
- .13 Protect wiring with tape or tubing at all points where abrasion may occur. Conceal wiring within fixture construction except where design or mounting dictates otherwise.
- .14 Splices:
 - .1 Minimize number of splices.
 - .2 Make with approved mechanical insulated steel spring type connectors, suitable for temperature and voltage conditions to which splices are to be subjected.
 - .3 Splices are not to be made unless properly terminated in accessible identified junction boxes.
- .15 Support luminaires directly by ceiling slab structure and not to formed steel decking, ceiling hangers, ductwork, piping, cable trays, etc.
- .16 Do not tighten wing nuts, bolts, or screws that allow fixture adjustment for recessed adjustable fixtures.
- .17 Install spread lenses only where called out on Schedule of Luminaires and Specifications.
- .18 Use cloth gloves when handling reflector cones, louvers, halogen lamps, glass, sconces and all exposed surfaces of fixtures.
- .19 Co-ordinate luminaire installation with work of other trades to ensure that necessary recessing depths and mounting spaces are provided.
- .20 Install luminaires in accordance with applicable architectural drawing reflected ceiling plans and/or wall elevations and/or field instructions issued by Consultant. Confirm luminaire locations prior to roughing-in. In equipment rooms, shafts and similar secondary areas, install luminaires after mechanical and other major work is roughed in and adjust luminaire locations as required.
- .21 Align and position all adjustable luminaires, and ensure that luminaires with adjustable lamp holders are properly positioned to correspond to lamps specified.
- .22 Comply with requirements of local governing electrical code regarding support of luminaires in suspended ceilings.
- .23 Independently suspend luminaires in suspended ceilings from ceiling slab. For each luminaire, provide minimum two (2) cable supports secured to ceiling slab and to luminaire. Confirm with local governing authorities and review with Consultant if a variance to this requirement can be made for specific luminaires of low weight.
- .24 Connect luminaires to power circuits and controls as required. Refer to drawings notes and schedules. Include for both normal and emergency power circuits as required.
- .25 Locate exit signs in final locations confirmed with Consultant and approved by local building code authority. Connect to power circuits as required. Where applicable for emergency power requirements, connect to emergency battery units. Relocate exit sign and re-direct direction arrows to suit local building code authority requirements and Consultant's directions.
- .26 Notify Consultant immediately and relocate if necessary as directed by Consultant, if:

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- .1 fixture placement is in conflict with a structural beam, mechanical duct, plumbing pipe, etc.;
- .2 space above ceiling is not sufficient;
- .3 any reason that a fixture cannot be located where it is dimensioned or shown on construction documents.
- .27 Existing luminaires designated to be relocated and reused, to be:
 - .1 disconnected, removed and stored in a safe area as designated by Owner until ready for re-installation;
 - .2 inspected, cleaned, repaired and re-lamped;
 - .3 identified to Consultant of requirement for replacement parts for broken lenses, faulty ballasts, broken mounting hardware, etc., as necessary to return luminaires to good working condition; identify cost to Consultant for repair/replacement parts.
- .28 Concrete Bases:
 - .1 Secure poles for pole mounted, exterior type luminaires to concrete bases as detailed.
 - .2 Co-ordinate required work including excavation/backfilling/concrete work to provide bases as shown.
 - .3 Provide anchor bolt covers and anchor bolt templates for proper positioning of anchor bolts in concrete.
 - .4 Refer to concrete base detail found on drawings; this detail is for general requirements only.
 - .5 Include costs for and engage Professional Structural Engineer licensed in Place of Work and with liability insurance, to review and endorse final base design work; review exact details with Consultant; grade levels may be different in various areas.
- .29 Extend ground conductors from metal parts of poles to building grounding provisions. Generally locate devices in locations on drawings, but base exact locations on coordination and review with Consultant and governing authorities. Confirm luminaires and pole finishes with Consultant prior to ordering. Run wiring in conduit.
- .30 Secure grade mounted building floodlighting luminaires to concrete pads set flush with finished grade level.
- .31 Provide seismic restraints to suspended luminaires, in accordance with latest local governing building code requirements.
- .32 Ground and bond luminaires as per local governing electrical code requirements.
- .33 If requested, demonstrate operation of luminaires intended for special applications such as building floodlights and other decorative purposes. Adjust their locations within a reasonable distance to obtain effects desired.
- .34 Test and adjust exterior luminaires at times after sunset, in presence of Consultant and at times acceptable to Consultant.
- .35 Prior to turn over of Work to Owner, clean luminaires in manner recommended by manufacturer and to satisfaction of Consultant.
- .36 Lamps to be new and intact when project is complete and ready for acceptance.

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- .37 Include a full lamp listing in Operating and Maintenance Instruction Manuals.
- .38 Additionally, refer to testing and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for products specified in this Section.

1.2 Product Compatibility

- .1 Lighting controls and luminaires when integrated together for control purposes must be 100% compatible with each other. Coordinate with ballast/driver and lamp manufacturers, LV relay panel manufacturers and dimmer/occupancy control manufacturers to ensure that components are compatible with each other and that interconnections do not affect performance, life or any warranties.

PART 2 - PRODUCTS

2.1 Photo Cells

- .1 Intermatic Inc., K4100 Series, CSA approved, 120/347 V as required, weather-proof photo-control with a hermetically sealed cadmium sulphide photo cell, colour coded leads, adjustable light level slide, swivel, threaded pipe stem and heavy duty die cast housing. Unit to be designed such that load remains on if cell fails, and to be complete with thermal inertia time delay to prevent switching by artificial light.
- .2 Acceptable manufacturers are:
 - .1 Intermatic Inc.;
 - .2 Paragon Electric;
 - .3 Tork Canada Ltd.
 - .4 Acuity Brands Controls

2.2 Photo Timer Controllers

- .1 Tork Phototimer series 5737TZ, CSA approved, microprocessor controlled photo timer with features as follows:
 - .1 silicon photosensor;
 - .2 microprocessor tracks dusk and dawn times for 24 hours and automatically sets its internal calendar in order to turn OFF at midnight during all seasons; back ON before dawn, and OFF at sunrise
 - .3 automatically adjusts for daylight savings time;

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- .4 two potentiometers are to be provided: one allows for field adjustment for longitude corrections or for additional energy savings; other allows user to set number of hours after middle of night that lights turn back on (AM burn);
- .5 solid brass locking type prongs;
- .6 relay provides positive snap action switching to assure a minimum contact life of 5000 operations;
- .7 surge protection provided using a metal oxide varistor of 160 joules minimum;
- .8 enclosure of ANSI colour code, high impact, UV stabilized polypropylene and contain a UV resistant clear acrylic window; base of ABS construction with a cross linked polyethylene gasket;
- .9 provides a load rating of 1000 watt tungsten, 1800 VA ballast;
- .10 must fail in the on position.
- .2 Include for required wiring, standard turn-lock receptacle and mounting hardware.
- .3 Acceptable manufacturers are:
 - .1 Tork;
 - .2 Intermatic;
 - .3 Paragon Electric.
 - .4 Acuity Brands Controls

2.3 Mechanical Time Switches

- .1 Intermatic Inc., V4547 Series, CSA approved, adjustable, surface wall mounted, mechanical time switch with Astro dial, skipper, carryover, 40 ampere rated switch contacts, and minimum EEMAC 3R raintight enclosure with lockable hinged door.
- .2 Time switch to adjust for seasonal changes automatically. Skippers to omit selected dates from program. Carryover to provide minimum 16 hours of pre-set schedule during power outages.
- .3 Exact model must suit intended application.
- .4 Acceptable manufacturers are;
 - .1 Intermatic Inc.;
 - .2 Paragon Electric;
 - .3 Tork Canada Ltd.
 - .4 Acuity Brands Controls

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2.4 Wall Box Dimmers

- .1 Cooper, ULC listed and labelled, CSA approved wall box dimmers as follows:
 - .1 of type and size to suit intended loads;
 - .2 air gap accessible without removing faceplate, to meet UL20 and UL1472 short circuit test requirement for snap switches;
 - .3 withstand voltage surges up to 600 V and current surges up to 200 A as per ANSI/IEEE C62.41;
 - .4 voltage regulated;
 - .5 power failure memory;
 - .6 LC filtering to minimize RFI;
 - .7 linear slide with smooth and continuous square law dimming curve operation;
 - .8 snap on faceplate (seamless multi-gang at locations with multiple devices);
 - .9 finish to Consultant's direction.
- .2 Where noted for applications of multiple wall box dimmers located in one location, provide CSA approved, NEMA 2 type, flush wall mounting, electrical cabinet with hinged locking front door, of painted enamel painted steel construction, complete with conduit knockout entries, flush trim and sized to accommodate dimmers. Refer to applicable drawing detail.
- .3 Acceptable manufacturer are:.
 - .1 Cooper;
 - .2 Legrand-Watt Stopper;
 - .3 Lutron;
 - .4 Leviton;
 - .5 NX Lighting Controls;
 - .6 Acuity Brands Controls

2.5 Occupancy Sensors (Standard)

- .1 Cooper, CSA approved devices to provide automatic control of lighting with following components:
 - .1 power and slave packs;
 - .2 dual technology occupancy sensors;
 - .3 controls and daylight sensors;
 - .4 wiring in conduit and mounting hardware.

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- .2 Where required, power packs to be self-contained, 347/120 VAC/24 VDC (or of voltage shown on drawings) transformer relay system. Slave packs to contain isolated relay. System to allow one sensor to control luminaires circuited to both essential power circuits and normal power circuits.
 - .3 For applications in general areas: ceiling mounted, PIR technology type occupancy sensors as follows:
 - .1 low voltage operation;
 - .2 360° lens area coverage, extending out up to 13 m (44') and area of 111 m² (1200 ft²);
 - .3 low profile ceiling mounting design;
 - .4 passive infrared technologies;
 - .5 integral light sensor;
 - .6 adjustable sensitivity and digital time delay;
 - .7 walk-through mode;
 - .8 LED indication of occupancy detection;
 - .9 isolated relay for interconnection to auxiliary control systems where required.
 - .4 For applications in general areas: ceiling mounted, dual technology type sensors as follows:
 - .1 combination passive infrared and ultrasonic technologies;
 - .2 when both PIR and ultrasonic technologies detect occupancy, lights turn ON automatically; once lights are ON, detection by either technology holds lights ON until occupancy is no longer detected and time delay elapses;
 - .3 low voltage operation;
 - .4 360° lens area coverage, extending out up to 6 m (20') and area of 92.9 m² (1000 ft²);
 - .5 low profile ceiling mounting design;
 - .6 integral light sensor;
 - .7 adjustable sensitivity and digital time delay;
 - .8 walk-through mode;
 - .9 LED indication of occupancy detection;
 - .10 isolated relay for interconnection to auxiliary control systems where required.
 - .5 For applications in general areas: ceiling mounted, DT-355, dual technology type sensors as follows:
 - .1 combination passive infrared and ultrasonic technologies;

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- .2 when both PIR and ultrasonic technologies detect occupancy, lights turn ON automatically; once lights are ON, detection by either technology holds lights ON until occupancy is no longer detected and time delay elapses;
- .3 can be set so that only one technology is needed to trigger;
- .4 low voltage operation;
- .5 360° lens area coverage, extending out up to 6 m (20') and area of 92.9 m² (1000 ft²);
- .6 low profile ceiling mounting design;
- .7 integral light sensor;
- .8 adjustable sensitivity and digital time delay;
- .9 walk-through mode;
- .10 LED indication of occupancy detection;
- .11 isolated relay for interconnection to auxiliary control systems where required.
- .6 For sensors mounted in ceiling/wall corners:
 - .1 combination passive infrared and ultrasonic technologies;
 - .2 when either or both (user set option) PIR and ultrasonic technologies detect occupancy, lights turn ON automatically; once lights are ON, detection by either technology holds lights ON until occupancy is no longer detected and time delay elapses;
 - .3 complete with adjustable swivel mounting bracket;
 - .4 wide dispersion lens area coverage, extending out up to 16 m (55') and area of 185 m² (2000 ft²);
 - .5 low voltage operation;
 - .6 low profile design;
 - .7 integral light sensor;
 - .8 adjustable sensitivity and digital time delay;
 - .9 walk-through mode;
 - .10 LED indication of occupancy detection;
 - .11 isolated relay for interconnection to auxiliary control systems where required.
- .7 For applications in washrooms and small storage rooms: wall mounted dual technology sensors as follows:
 - .1 wall switch sensor turns lights OFF and ON based on occupancy;
 - .2 factory default operation is for Manual-ON mode, so that users turn light on only when needed;

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- .3 variety of control options including Auto-ON operation, walk-through and test mode; additional settings allow choice of which sensing technologies hold ON or retrigger lighting;
 - .4 colour matched lens and low profile design;
 - .5 wide dispersion lens area coverage, extending out up to 10 m (35') and area of 37 m² (400 ft²);
 - .6 infrared and ultrasonic technologies;
 - .7 adjustable time delays and sensitivity;
 - .8 manual pushbutton operation (override);
 - .9 low voltage or line voltage operation to suit specific applications;
 - .10 complete with required mounting accessories.
- .8 For corridors or wide space coverage: Ceiling mounted, ultrasonic technology type sensors as follows:
- .1 ultrasonic technologies;
 - .2 when ultrasonic technology detects occupancy, lights turn ON automatically; once lights are ON, detection holds lights ON until occupancy is no longer detected and time delay elapses;
 - .3 low voltage operation;
 - .4 corridor applications to include linear lens area coverage, extending out up to 13.5 m (45') in 2 directions;
 - .5 wider spaces applications to include wide dispersion coverage to suit space, up to 200 m² (2200 ft²);
 - .6 low profile ceiling mounting design;
 - .7 integral light sensor;
 - .8 adjustable digital time delay;
 - .9 LED indication of occupancy detection;
 - .10 isolated relay for interconnection to auxiliary control systems where required.
- .9 Override switches to be wall mounting in single gang recessed outlet boxes.
- .10 Day light sensors to be provided where required for dimming or controlling lights in areas of windows and atriums/sky lights.
- .11 Where both normal and emergency power circuited luminaries exist, provide emergency power control unit that allows sensor to control both emergency power circuited luminaries as well as normal power circuited luminaries, and when normal power is lost, forces on emergency power circuited luminaries.

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- .12 Relays to be provided as required to integrate sensors to BAS. Coordinate exact requirements with central lighting control system vendor and BAS vendor.
- .13 Wiring in conduit, mounting hardware and ancillary devices to be provided as per Manufacturer requirements.
- .14 System to be complete with initial 1 year parts and labour warranty, with additional extended 5 years parts warranty.
- .15 Include for and arrange for Manufacturer authorized representative to perform on site testing, verification and certification of installed system. Refer to Part 3 installation article for additional requirements.
- .16 Where sensors are interconnected to dimming system, ensure that they are 100% compatible with respective control systems, dimmers and ballasts. Confirm with respective equipment manufacturers and obtain in writing that such integrations are acceptable to each manufacturer.
- .17 Where devices are connected to central lighting control system, acceptable device manufacturers to be as recommended by manufacturers of central lighting control system.
- .18 Generally, acceptable manufacturers are:
 - .1 Cooper;
 - .2 Legrand-Watt Stopper;
 - .3 Lutron;
 - .4 Leviton;
 - .5 NX Lighting Controls;
 - .6 Acuity Brands Controls

PART 3 - EXECUTION

3.1 Installation of Outside Lighting Control

- .1 Provide a photo cell to switch designated outside lighting on, and time switch as required for programmed "off" control. Provide relays/contactors for control connections to multiple lighting loads. Refer to drawing details and notes for exact requirements. Provide required wiring in conduit and system connections to provide outside lighting control.
- .2 Install components in accordance with Manufacturer instructions to suit specific installation requirements.

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- .3 Flush mount photo cell in north exterior wall of building at a height to permit cleaning. Confirm exact location prior to roughing-in.
- .4 Connect lighting circuits to photo cell and to time switch which will be located adjacent panelboard.
- .5 When outside lighting control work is complete, test operation of control system and adjust as required.
- .6 Confirm exact sequence of operation with Consultant prior to start of Work.

3.2 Installation of Timers

- .1 Provide timers to control lighting and other equipment as required and confirmed by Consultant.
- .2 Exact type of timers to be verified by manufacturer/supplier to ensure proper compatibility to interconnected equipment and loads. Confirm with respective manufacturers.
- .3 Install devices in accordance with Manufacturer instructions. Provide wiring in conduit. Provide required power connections and interconnection to luminaires, equipment, and power panels.
- .4 Programme timers as per schedule confirmed with Owner and/or Consultant.
- .5 Provide engraved nameplate identifying each timer.
- .6 After installation, adjust, test, and verify operation.

3.3 Installation of Wall Box Dimmers

- .1 Provide flush wall box dimmers in locations and connect to control lighting as indicated. Confirm exact locations prior to roughing-in. Equip each dimmer with a faceplate. Confirm faceplate colour prior to ordering.
- .2 Install components in accordance with Manufacturer instructions to suit specific installation requirements.
- .3 Where identified, provide central enclosure cabinet for mounting dimmers within and connect complete. Clearly identify each dimmer and enclosure with engrave Lamacoid nameplates. Confirm exact nomenclature with Consultant prior to ordering.
- .4 When installation is complete, check and test operation of each dimmer and adjust as required.
- .5 Ensure that each dimmer is properly sized to suit connected load.

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3.4 Installation of Occupancy Sensors

- .1 Provide occupancy sensors and daylight sensors and associated devices to control lighting in areas as required. Provide power packs as required with suitable voltage and power ratings.
- .2 Exact type of occupancy sensors and type of lenses to be verified by manufacturer/supplier to ensure proper coverage in sensed areas only, and compatibility to interconnected systems. Confirm with respective manufacturers.
- .3 Be responsible for providing, locating, and aiming appropriate sensors in correct location required for complete and proper volumetric coverage within range of coverage(s) of controlled areas per Manufacturer recommendations. Rooms to have 90-100% coverage to completely cover controlled area to accommodate occupancy habits of single or multiple occupants at any location within room(s). Locations and quantities of sensors shown and/or noted are illustrations only and should only be used as guidelines. Provide additional sensors if required to properly and completely cover respective room.
- .4 Verify with Manufacturer factory authorized representative, exact type of sensor to be used in each area, placement of sensors and installation criteria, to best meet requirements of end user. Manufacturer representative should be consulted for more non-typical installation types. Ensure that sensors connected to dimming system are 100% compatible with dimming system.
- .5 Where luminaires in rooms/areas are fed from normal and emergency power circuits, provide suitable relays and provisions to ensure that operation of luminaires on emergency power are maintained during loss of normal power.
- .6 Proper judgement must be exercised in executing installation so as to ensure that best possible installation in available space and to overcome local difficulties due to space limitations or interference of structural components. Also provide, at Owner's facility, training necessary to familiarize Owner personnel with operation, use, adjustment, and problem solving diagnosis of occupancy sensing devices and systems.
- .7 Install devices in accordance with Manufacturer instructions. Provide wiring in conduit. Provide required power connections and interconnection to luminaires and power panels. Provide manual switches to override control system in each area/room as shown.
- .8 Confirm finishes of sensors with Consultant prior to ordering.
- .9 Confirm mounting heights with Architect and manufacturer prior to roughing-in and installation.

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- .10 Adjust sensitivity and time delays to best suit Owner furniture layout drawings. Allow for minor adjustments of locations (1 m [3.3']) of sensors.
- .11 After installation is complete, provide for Manufacturer authorized representative to inspect, test and verify system performance and installation.
- .12 After completion of project and within 30 days after Owner has taken occupancy and furnishings are in place, provide for Manufacturer authorized representative to revisit site to test and make final adjustments.
- .13 Refer also to testing and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

3.5 Installation of Low Voltage Lighting Controls

- .1 Provide low voltage lighting components as required. Connect complete.
- .2 Install components in accordance with Manufacturer instructions to suit specific installation requirements.
- .3 Flush mount low voltage switches into wall mounted electrical boxes. Provide suitable mounting bracket and faceplate for each switch. Confirm finishes with Consultant prior to ordering.
- .4 Install power supplies, transformers and relays in barriered electrical boxes/enclosures and locate adjacent to surface mounted panel boards to which lighting loads are connected or in accessible ceiling space above recessed mounted panel boards to which lighting loads are connected. Exact locations to be confirmed with Consultant prior to start of work.
- .5 Locate locations of boxes on as-builts.
- .6 Clearly label each box and label low voltage switching circuits.
- .7 Refer also to testing and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for products specified in this Section.

PART 2 - PRODUCTS

2.1 Emergency Lighting Units

- .1 Emergi-lite "ESL" Series, CSA approved, 120 VAC/12 VDC emergency lighting battery units. Units are complete with batteries, charger, dual lamp heads per unit (where shown); cabinet and 1.2 m (4') AC cord and plug set. Units to also be complete with automatic testing and self-diagnostic circuitry, and remote monitoring provisions. System to be designed to provide emergency lighting levels in accordance with local governing building requirements.
- .2 Chargers are fully automatic, solid-state type that automatically and instantaneously energizes lamp load upon failure of AC supply. Battery protection circuit automatically shuts down lamp load when battery reaches full discharge. Chargers to fully recharge battery in 12-24 hours and be current limited and short circuit proof.
- .3 Batteries to be long life sealed lead, maintenance free and have a capacity to supply sufficient output power to lamp loads and to exit sign emergency loads for a period of time in accordance with latest requirements of local governing building code but be a minimum of 30 minutes. Batteries to be designed for and guaranteed for at least 10 years of life expectancy.
- .4 Cabinets are constructed of No. 18 gauge steel, finished in white enamel. Front cover is removable to provide easy and full access to battery and charger connections. Knockouts are provided on top for lamp heads. Cabinet includes protective wire-guard, where required and/or where identified with "WG" designation on drawings.
- .5 Units include "PUSH-TO-TEST" switch, AC and high charge pilot lights and AC cord set.
- .6 Integral lamp heads are 12V, 6 W MR16 LED lamps, decorative design, high impact plastic, adjustable heads.
- .7 Unless otherwise scheduled in Schedule of Luminaires, provide remote lamp heads as follows:
 - .1 remote surface mounted heads in climate controlled areas to be type EF40 series, vandal resistant heavy duty, clear, UV resistant polycarbonate lens type, die cast aluminum back plate, single and double adjustable head, 181 mm L x 117 mm W x 95 mm D (7-1/8" x 4-5/8" x 3-3/4"); complete with 12V, 6 W MR16 LED lamps;
 - .2 remote surface mounted heads in climate controlled areas to be type EF26 series, vandal resistant, frosted polycarbonate cube type, single or double adjustable heads, complete with 12V, 6 W MR16 LED lamps; single unit approximately 121 mm L x 124 mm W x 121 mm D (4-3/4" x 4-7/8" x 4-3/4");

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- .3 remote surface mounted heads in climate controlled equipment rooms and building maintenance/service areas to be No. EF9 series, single, double or triple adjustable swivel fire retardant thermoplastic heads with 12V, 6 W MR16 LED lamps; single unit approximately 114 mm L x 184 mm H x 89 mm D (4.5" x 7.25" x 3.5"); fixtures identified with "WG" to be complete with wire guard;
- .4 remote surface mounted heads in climate controlled equipment rooms and building maintenance/service areas to be No. EF18 series, single, double or triple, large adjustable swivel fire retardant thermoplastic heads with 12V, 6 W MR16 LED lamps; single unit approximately 114 mm L x 184 mm H x 89 mm D (4.5" x 7.25" x 3.5"); fixtures identified with "WG" to be complete with wire guard;
- .5 remote recessed mounted heads in climate controlled areas to be type EF15 series gimbal ring adjustable "eyeball"; overall ring diameter of 200 mm (8") and in-ceiling depth of 86 mm (3-3/8"), with 12V, 6 W MR16 LED lamps;
- .6 remote surface mounted heads in non-climate controlled areas to be type EF39 series, NEMA 4X certified, weather-proof, vandal resistant fully gasketed cast aluminium back plate with polycarbonate lens, single and double adjustable head complete with 12V, 6 W MR16 LED lamps;
- .7 remote in suspended ceiling type battery units to be provided as per Schedule of Luminaires; remote heads connected to these battery units to be provided as per drawing Schedule of Luminaires;
- .8 remote heads to be of tamper proof construction;
- .9 wire-guards where identified with "WG" designation on drawings.
- .8 Include for Manufacturer authorized representative to perform on-site after installation inspection, testing, adjusting, and verification of equipment. Such work to be performed during premium after hours' time. Refer to Part 3 for additional requirements.
- .9 Acceptable manufacturers are:
 - .1 ABB Emergi-lite;
 - .2 Lumacell;
 - .3 Beghelli (supplied by Omnilumen);
 - .4 Redi-lite
 - .5 Aimlite.
 - .6 WSC Lighting Systems

2.2 Combination Emergency Lighting Battery Units & Exit Signs

- .1 Emergi-lite "Premier" Series, CSA C22.2 No. 141 certified, CSA-C860 approved, combination emergency lighting battery units and exit signs. System to be designed to provide emergency lighting levels in accordance with local governing building requirements.
- .2 Units are complete with batteries, charger, dual lamp heads per unit and features as follows:
 - .1 dual 120/347V AC input and 12V DC output;
 - .2 one-piece unit frame and face plates made of injection-moulded white durable high-impact thermoplastic;

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- .3 snap in/out chevrons; no screws are necessary to hold the faceplate or backplate to housing;
 - .4 faceplates feature uniformly illuminated legend using LEDs to provide illumination in normal and emergency operation and mounted inside housing; LED-sensitive diffuser is mounted behind legend to provide the 150 mm (6") high by 20 mm (3/4") stroke letters with even illumination;
 - .5 equipped with self-testing / self-diagnostic features that automatically self-tests for one minute every 30 days, 10 minutes in 6th month and 30 minutes annually; when a fault is detected, bi-colour pilot light turns from green to red and flash, identifying source of failure (battery, charger circuitry, lamp load, LED strip);
 - .6 vandal-resistant shield with tamper-proof screws;
 - .7 unit suitable for wall or ceiling mount.
- .3 Chargers are fully automatic, solid-state type that automatically and instantaneously energizes lamp load upon failure of AC supply. Battery protection circuit automatically shuts down lamp load when battery reaches full discharge. Chargers to fully recharge battery in 12-24 hours and be current limited and short circuit proof.
 - .4 Batteries to be long life sealed lead, maintenance free and have a capacity to supply sufficient output power to lamp loads and to exit sign emergency loads for a period of time in accordance with latest requirements of local governing building code but be a minimum of 60 minutes. Batteries to be designed for and guaranteed for at least 10 years of life expectancy.
 - .5 Units include test switch and a green pilot light, located on face plate above legend.
 - .6 Integral lamp heads are 12 V, 6 W, LED, decorative design, high impact plastic, tool-less adjustable swivels, dual heads.
 - .7 Include for Manufacturer authorized representative to perform on-site after installation inspection, testing, adjusting, and verification of equipment. Such work to be performed during premium after hours' time. Refer to Part 3 for additional requirements.
 - .8 Acceptable manufacturers are:
 - .1 ABB Emergi-lite;
 - .2 Lumacell;
 - .3 Aimlite;
 - .4 Beghelli (supplied by Omnilumen);
 - .5 Read-lite.
 - .6 WSC Lighting Systems

PART 3 - EXECUTION

3.1 Installation of Emergency Lighting Units

- .1 Provide emergency lighting battery units and lighting heads as specified herein and on Schedule of Luminaires, and mount where required. Connect battery units complete to dedicated emergency circuit of local power panels designated for this purpose or where identified on drawings, plug into designated adjacent receptacle. Provide wiring in conduit and connections to remote lamp heads and extend to central battery unit serving area.

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- .2 Install units such that units to be automatically actuated upon failure of power supply to normal lighting in area covered by that unit equipment.
- .3 Connect exit signs to battery units circuits in applications where exit signs require backup DC supply.
- .4 Install combination units in locations and connect complete.
- .5 Obtain required training from Manufacturer representative on any special installation procedures. Install units in accordance with Manufacturer instructions to suit specific installation requirements.
- .6 Note that drawings identify location for battery units and generally identify circuiting of remote heads. In absence of direction of circuiting, provide wiring in conduit to feed remote heads and exit lights from nearest battery unit with sufficient capacity in area, in accordance with application requirements, Manufacturer requirements, and applicable codes. Multiple battery units may be required to accommodate connection of remote heads in some areas. Provide sufficient battery units to accommodate connected lamp loads and system design time of operation. Where more than one battery unit is installed in same immediate location, only one unit is required to be provided with integral lamp heads.
- .7 Where battery model number is noted, it is for general reference and exact capacity may be required to be increased to suit connected loads and required battery output time duration to suit local governing codes. Ensure that emergency lighting operates at lighting levels and for duration to meet local governing codes.
- .8 Provide remote mounting lamp heads as specified and refer to Schedule of Luminaires where additional requirements may be identified. Provide remote mounting lamp heads in locations to provide system performance in compliance with requirements of Documents and where applicable, local governing building code. Connect complete to battery units. Be responsible for revisions to system, including relocations, aiming and additional remote heads as determined by testing results. Generally, provide wiring in accordance with Manufacturer requirements but be minimum No. 10 AWG, and increased to suit voltage drop requirements recommended by system manufacturer to comply with local electrical code requirements. Confirm finish requirements with Consultant prior to ordering.
- .9 Provide wiring in conduit and install devices in accordance to Manufacturer instructions. Comply with local governing codes and authority requirements with regards to providing fire rated conductors (MI) for life safety applications.
- .10 When installation of emergency lighting equipment is complete, and in conjunction with Manufacturer authorized representative, inspect and test entire system, adjust as required, and certify in writing to Consultant that system is complete, have been tested, adjusted, and are in proper operating condition. Also, be responsible for engaging emergency lighting manufacturer to perform an illumination level test in presence of Consultant, throughout all areas of building. Manufacturer technician to be responsible for properly aiming remote light heads, recording light level readings on a record set of floor plans and calculating light level readings. Co-ordinate and arrange for local authority building inspector approvals. Prepare and submit to Consultant a letter on Manufacturer letterhead and signed by Manufacturer authorized technician, stating that emergency lighting levels meet requirements of local building code requirements and applicable CSA Standards. Notify Owner and Consultant at least 10 days prior to propose testing date. Testing dates and times to be reviewed with Consultant.

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- .11 Provide minimum one hard bound copy and electronic copy of signed test report.

3.2 Training

- .1 Manufacturer trained technician to perform onsite training of each user (including the provision of user guides) prior to project completion to ensure that users are properly trained in the operation and maintenances of system.
- .2 Refer to Instructions to Owner specified in Section titled Electrical Work General Instructions.

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PART 1 - GENERAL

1.1 Submittals

- .1 Submit shop drawings for products specified in this Section. Include annunciator schedules and a sample of graphic annunciator layout and nomenclature.

1.2 Software Nomenclature Reprogramming

- .1 Include additional costs for system manufacturer to make necessary on site final changes to applicable system/equipment software. Make such changes after successful testing and verification of systems, but prior to turn over to Owner. After successful final verification of work, confirm and obtain approval of final nomenclature in writing from Owner and Consultant. Software revisions to incorporate final room names/area names/building names and equipment identification.

PART 2 - PRODUCTS

2.1 Fire Alarm System Products - General Features

- .1 CSA approved and ULC listed and labelled components for a fully electrically supervised, addressable, microprocessor based, single stage, zoned, modular, fire alarm system.
- .2 System components to be listed as products of a single manufacturer under appropriate category, by Underwriter's Laboratories of Canada and bear ULC label. system components and work in conjunction with system installation to meet specific application requirements of local governing authorities, codes, standards, regulations and requirements of following:
 - .1 CAN/ULC-S524;
 - .2 CAN/ULC-S527;
 - .3 CAN/ULC-S537;
 - .4 local governing building code;
 - .5 local governing electrical code;
 - .6 local governing building permit applications for approvals;
 - .7 other requirements of local governing authorities.
- .3 Devices to be ULC listed and labelled devices suitable for fire alarm applications. Power supplies and other components to be CSA approved where required by local governing authorities and codes.
- .4 System to include following components:
 - .1 main control panel with liquid crystal display (LCD) and integral light emitting diode (LED) annunciator and system software; capacity for required schedule of zones, system points plus minimum additional spare 25% zones and points;
 - .2 remote annunciators;
 - .3 alarm initiating devices;
 - .4 alarm signalling devices;

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- .5 batteries and battery chargers, end-of-line devices and required ancillary devices;
- .6 wiring in conduit.
- .5 Exact type of device to be used in each area of installation to be as recommended by system manufacturer to suit specific applications and to be approved for such use as per ULC standards. Devices in non-climatic controlled areas to be weatherproof, corrosion resistant and ULC listed for use in below freezing temperatures. System manufacturer to be responsible for ensuring compliance with these requirements.
- .6 Control Panel:
 - .1 Control panel features:
 - .1 surface mounted when installed in unfinished areas;
 - .2 recessed mounted when installed in finished areas;
 - .3 solid-state microprocessor based technology with LCD and integral LED annunciator with alarm and trouble LED's for each scheduled zone; annunciator provisions to be common with remote annunciator;
 - .4 dead front, modular cabinet assembly with trim, a hinged door with full glazing, a lock, and keys; door provides access to operator controls, but does not expose live electrical connections; controls, indicators, and operating instructions clearly visible through a viewing window; electrical connections are front access through a removable inner protective cover.
 - .2 Panel allows for loading or editing of special instructions and operating sequences as required and is capable of on-site programming to accommodate expansion and changes required by local codes. Software operations and instructions are stored in a non-volatile programmable memory in event of loss of primary and secondary power.
 - .3 On site programming changes to fire alarm system is password protected. During construction stage, obtain approval in writing from Consultant and local governing fire authority, of programming (system sequence of operation) and custom label changes. System software to be custom programme as required.
 - .4 Include for system programming changes required for duration of project and as required for final acceptance and certification of entire system and project work, by local governing fire and buildings authorities. Include for additional one (1) onsite system reprogramming sessions (duration minimum 4 hours) for any required revisions, after system verification/commissioning. Provide re-burning as required by local governing fire authority.
 - .5 Ability to selectively program input/output control functions based on ANDing, ORing, NOTing, Timing, and Special Coded Operations is also to be incorporated in resident software programming of system.
 - .6 System to have ability to manually disable and enable any device/circuit individually, via software, for maintenance or testing purposes.
 - .7 System can program selected or all smoke sensors for alarm verification operation.
 - .8 System can program an adjustable time delay circuit for each water flow initiating circuit to prevent false alarms that may be caused by erroneous pressure surges in sprinkler system.

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- .9 Wiring to any remote annunciator to be supervised for open and ground conditions
- .10 Properly ground and bond control panels and remote annunciator cabinets to building ground. Conduit ground will not be acceptable. Provide green coloured grounding loop, a minimum #10 AWG. insulated copper run in conduit. Connect ground loop to main building ground system source. Do not run ground wire in same conduit as fire alarm and communication wiring.
- .11 Control panel LCD indicates alarms, supervisory service conditions and troubles. Panel includes but is not limited to following:
 - .1 8 lines by 21 character LCD display;
 - .2 2500 addressable point capacity;
 - .3 15 hardwired circuit capacity;
 - .4 local energy, shunt master box, or reverse polarity remote station connection;
 - .5 form C trouble contact;
 - .6 earth ground supervision circuit;
 - .7 front panel ground fault isolation control;
 - .8 8 amp intelligent power supply;
 - .9 automatic battery charger;
 - .10 standby batteries;
 - .11 resident non-volatile programmable operating system memory for operating requirements;
 - .12 five programmable multi-function keys with status LED's;
 - .13 red fire alarm LED and acknowledge button;
 - .14 red priority 2 LED;
 - .15 yellow supervisory service LED and acknowledge button;
 - .16 yellow trouble LED and Acknowledge button;
 - .17 green power on LED;
 - .18 alarm/signal silence LED and button;
 - .19 system reset button;
 - .20 operator interface keypad for manual control and system information access;
 - .21 addressable interface control modules (as required);
 - .22 serial DACT module;
 - .23 supervised annunciator circuit.
- .12 Control Panel is capable of chronologically logging and storing minimum 300 events in an alarm log and minimum 300 events in a trouble log. Historical logs are stored in CPU's memory and are protected by a lithium battery that is supervised for a low battery condition. Each recorded event includes time and date of that event's occurrence. Alarm log file is separate from trouble log file. User to be able to generate a report of both logs upon request.

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- .13 Hardwired initiation and control circuits to be individually configurable, on site, in any combination, to provide initiating circuit, signal circuit, or auxiliary control circuit operation. These circuits include a Ground Fault Isolation Relay, allowing them to be isolated via front panel keyboard without having to remove any field wiring.
- .14 Initiation circuits/addresses are individually configurable on site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a non-latching monitoring circuit or an alarm verification circuit.
- .15 Notification appliance circuits (NAC), (speaker/strobe circuits), are independently supervised and fused such that a fault on one circuit does not affect operation of any of other circuits. NACs are configured as follows:
 - .1 Class "B" wiring, current limited;
 - .2 rated at two amps of continuous power;
 - .3 capable of powering polarized 24 VDC audible/visual signalling appliances;
 - .4 supply two NAC s per floor.
- .16 Auxiliary control circuits are as follows:
 - .1 central Station alarm output;
 - .2 central station trouble output;
 - .3 SPDT Form C relays fused at 2 Amp @ 24 VDC.
- .17 System Expansion Modules connected by ribbon cables are supervised for module placement. Should a module become disconnected system trouble indicator illuminates and audible trouble signal sounds.
- .18 Fire Alarm Control Panel supports 2 RS-232-C I/O ports. CPU data output to I/O ports are in a parallel ASCII format at field adjustable baud rates of 220, 300, 1200, 2400 and 4800.
- .19 System is of modular design to allow future expansion with a minimum of hardware additions and system interruptions.
- .20 Isolators to be provided between building dividing walls, where required by local governing authorities and codes and as recommended by system vendor.
- .21 Control panel to have minimum 25% spare supervisory and annunciating capacity and provide following functions:
 - .1 fire alarm control;
 - .2 fire alarm annunciation;
 - .3 supervisory and trouble annunciation.
- .22 Panel to include circuitry and devices to transmit an alarm signal to device(s) provided by others (Owner arranged monitoring company) to send alarm signal to Fire Department or to an outside private protection company, in accordance with CAN/ULC-S561. Exact requirements to be coordinated with monitoring company and and/or security company.

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- .23 A serial digital alarm-communicating transmitter (SDACT) is a module that mounts internally to and communicates directly with fire alarm control panel. SDACT monitors status of host fire alarm control panel and its connections to central station-monitoring receiver. When status changes require information to be reported, SDACT provides a per point message, (i.e. every addressable device within system on an individual basis), that can assist central station in more accurately implementing required response. Typical information reports include alarms, troubles, and supervisory conditions with specific point identification.
- .24 Amplifiers and tone generators supply required signals for tones to audible devices and are sized to accommodate audible device loads (assume 1 watt tapping for determination of amplifier capacity). Amplifiers to be continuously supervised for proper operation. Amplifiers to be sized to include 20% power output spare future capacity.
- .7 Walk-test with History Logging:
 - .1 Provide necessary software and programming to provide one-man system testing, as follows:
 - .1 initiating walk-test mode automatically disconnects auxiliary control circuit relays, and creates a system trouble indication on control panel;
 - .2 alarm activation of any initiating device causes audible signals to pulse one round of code over alarm signal circuits identifying zone of alarm to testing technician without having to return to control panel. alarm-initiating zone is silently logged as being tested in historical data file. panel automatically resets itself after logging of alarm;
 - .3 any momentary opening of an initiating or indicating appliance circuit causes audible signals to sound for 4 seconds to indicate trouble condition. trouble condition is silently logged as a trouble condition in historical data file. panel automatically resets itself after logging of trouble condition;
 - .4 if walk-test feature is on for an inappropriate, (programmable), amount of time, system reverts to normal mode automatically;
 - .5 actuation of walk-test program not to require any special tools or programming knowledge by Owner or operator.
- .8 Power Supply:
 - .1 Control panel accepts 120 volts, 60 Hz as primary source of power for system and additionally provides 24 volts regulated output, current limited distributed system power. Primary power failure of power loss (less than 102 volts) activates common trouble sequence.
 - .2 Direct current (dc) emergency power supply consists of battery power source to supply sufficient standby capacity to operate entire system upon loss of normal power. Emergency power supply controls, battery charger, and batteries provide an automatic un-interruptible transfer of power to loads during primary power failure or loss. During normal operating conditions a fault in battery charging circuit or a short or open in battery leads, to activate common trouble sequence. Continuous supervision of wiring for initiating and alarm circuits to be maintained during power failure.

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- .3 Size batteries in accordance with latest requirements of local governing building code. Batteries to be maintenance free, dual-sealed gelled cell type equipped with charging circuits capable of recharging fully depleted batteries to within 70% of their maximum capacity within 12 hours. ampere-hour capacity to be adequate to operate system under supervisory conditions for a minimum of 24 hours with AC power disconnected, and to provide emergency power under full load for local governing building code required length of time but which must be at least 30 minutes at end of this period. Confirm exact requirements with local governing fire authority. Test, verify, and demonstrate these requirements as specified in Part 3 of this Section. system automatically transfers to standby batteries upon power failure. Battery charging and recharging operations are automatic.
- .4 Power supply and control equipment include transient voltage surge protective device as recommended and provided by fire alarm system manufacturer.
- .9 Addressable Device Network:
 - .1 System provides communication with addressable initiating devices. These devices are annunciated on control panel's main LCD/LED display. Annunciation includes following conditions for each point:
 - .1 Zone/Device Location;
 - .2 Type of Device;
 - .3 Detector Status (Normal/Alarm/Trouble);
 - .4 Device Missing/Failed.
 - .2 A minimum of 100 addressable devices may be multi-dropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.
 - .3 Communication format is completely digital poll/response protocol. A high degree of communication reliability is obtained by using parity data bit error checking routines for address codes and check sum routines for data transmission portion of protocol.
 - .4 Each addressable device to be uniquely identified by an address code entered on each device at time of installation. Use of jumpers to set address is not acceptable due to potential of vibration and poor contact.
 - .5 System supports 100% of addressable devices in alarm or operated at same time, under both primary (AC) and secondary (battery) power conditions. Systems which cannot support 100% of their point capacity in alarm simultaneously are not acceptable.
 - .6 System to allow a line distance of up to 2,500 feet to furthest addressable device on a Class A communications circuit. Run each addressable loop wired Class A, and run in a Class A conduit system with return run separated by a minimum of 600 mm (24") from primary run. Appropriate quantity of isolator modules to be installed so that a wiring fault (short, open, or ground) within one floor area does not prevent normal operation of other addressable devices on other floor areas.
- .10 Remote Trouble Indicator:
 - .1 Remote trouble indicator unit includes a yellow LED that illuminates and a low frequency piezo that sounds upon a trouble condition being received at main control panel. unit resets when controlling contact is reset.

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- .11 Remote Annunciators:
 - .1 Remote active annunciator to be flush wall mounted with baked enamel finish to Architect's direction, and be complete with following features:
 - .1 alarm LED for each fire zone;
 - .2 supervisory LED for each sprinkler and standpipe zone;
 - .3 each zone shown separately and identified by different colour;
 - .4 alarm and supervisory zones identified with white lamacoid plate with black lettering;
 - .5 LCD display indicating address of device in alarm and details of system operating conditions;
 - .6 LED of high intensity types and are supervised;
 - .7 trouble buzzer;
 - .8 tamper resistant mounting hardware.
 - .2 Multi coloured passive graphic display as follows:
 - .1 electronically stored floor and zone outline, printed on dimensionally stabilized clear film with 3 mm (1/8") thick clear acrylic shield with UV protection;
 - .2 floor outline and zone area designation depicted by a black border with each zone area represented by a separate colour; egress corridors illustrated with black dotted design with zone colour shown behind pattern; colours and outlines to be confirmed with and approved by Consultant;
 - .3 exit doors, fire hose cabinets, Siamese connections, elevators, sprinkler pump, gas shut off valves, etc. indicated;
 - .4 "YOU ARE HERE" notation in red;
 - .5 a minimum of 6 colours utilized in display;
 - .6 anodized aluminum frame (minimum 600 mm x 1 m [2' x 3']) to match finish of remote annunciator; finishes to approval of Consultant;
 - .7 tamper resistant mounting hardware;
 - .8 approved by local fire authority, where required.
- .12 Addressable Modules:
 - .1 Addressable modules to be used for monitoring of water flow, valve tamper, non-addressable detectors, and for control of fans or dampers that require shutdown or manual control in an alarm condition.
 - .2 Addressable modules to monitor any N/O contact device and be capable of powering 2-wire smoke detectors. Addressable modules will communicate zone's status (normal, alarm, trouble) to transponder. Addressable modules zone address to be set at time of installation via a dip switch package. Where multiple addressable modules are required within a room, (for example a sprinkler room), cabinet mount addressable modules in a locked box, keyed to match fire alarm control panel. Neatly arrange addressable modules for easy contractor connection and label each addressable module with a lamacoid plate providing zone, device address and custom label.

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- .3 Addressable modules to be able to provide supervised or non-supervised control of any control function. Addressable modules will communicate zone's status (normal, trouble) to transponder. Addressable modules to provide a double pole double throw relay for switching loads of up to 120 VAC. Each common leg of relay to be equipped with a replaceable 2 AMP fuse. Addressable modules zone address to be set at time of installation.
- .13 Manual Pull Stations:
 - .1 Manual pull stations to be addressable, single stage, single action, non-coded, semi-flush mounted type. Pull stations are of die cast metal construction with red enamel finish and "PULL IN CASE OF FIRE" lettering. Stations include front break-glass rod, tamper proof reset function, and one set of N/O contacts. Contacts close when handle is pulled down with single action, breaking glass rod and activating fire alarm condition.
 - .2 Addressable pull station electronics including diagnostic LEDs are mounted on station and distinct address is set on station at time of installation.
 - .3 Include plaster cover for semi-flush mounting and suitable back box. Where surface mounted include for compatible surface mounted style red box. Include additional auxiliary set of contacts where required for interconnection to other building systems.
 - .4 Equip stations located in areas of high abuse or where designated to be complete with guard, with STI type, ULC listed and labelled, hinged clear Lexan cove. Where specified or where required by code or local fire authority, include integral audible alarm to sound when cover is opened.
 - .5 For non-climate controlled applications, provide weatherproof STI type, ULC listed and labelled, hinged clear Lexan cover. Where specified or where required by code or local fire authority, include integral audible alarm to sound when cover is opened.
 - .6 Provide wireguards over stations identified as "WG".
- .14 Thermal Detectors:
 - .1 Surface ceiling mounted addressable automatic thermal detectors with features as follows:
 - .1 low silhouette design and twist-lock mounting to base;
 - .2 integral microprocessor with non-volatile memory, automatic device mapping, electronic addressing, self-diagnostics and history log;
 - .3 LED status indication;
 - .4 field configurable mounting mechanism to prevent unauthorized removal;
 - .5 combination 135°F (57°C) fixed temperature and 15°F (9°C) rate-of-rise type;
 - .6 135°F (57°C) fixed temperature type.
 - .2 Each detector to be complete with a base plate for mounting to a standard 4" (100 mm) outlet box and cast guards for detectors. Where required, provide an additional alarm relay (Form C, SPDT), normally open contact, for auxiliary functions.

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- .15 Ceiling Mounted Products of Combustion Detectors:
 - .1 Surface ceiling mounted photoelectric type, addressable, products of combustion (smoke) detectors with features as follows:
 - .1 low silhouette design and plug-in mounting to base;
 - .2 integral microprocessor with non - volatile memory, automatic device mapping, electronic addressing, self-diagnostics and history log;
 - .3 sensitivity range from 0.6% to 1.9% per foot;
 - .4 environmental compensation;
 - .5 identification of dirty or defective detectors;
 - .6 an integral LED alarm lamp;
 - .7 locking feature to prevent unauthorized removal of unit head from base.
 - .2 Each detector to be complete with a base plate equipped with wiring terminals, for mounting to a standard 4" (100 mm) octagon box. Provide cast guards for detectors where identified on drawings. Where required, provide an additional alarm relay (Form C, SPDT), normally open contact, for auxiliary functions.
 - .3 Detectors tied to hold open devices to be complete with required auxiliary set of contacts. Co-ordinate work with supplier of hold open devices.
 - .4 Equip detectors with a dust cover, to be removed at time of verification to prevent dust and dirt entering smoke chamber during construction work.
- .16 Detector Bases:
 - .1 Various types of bases are required to suit each respective application. Confirm with system manufacturer, and provide required type for each application. Types include:
 - .1 standard type equipped with wiring terminals, for mounting to a standard 100 mm (4") octagon box and complete with tamper-resistant mechanism to prevent unauthorized removal of unit head from base;
 - .2 relay type with features similar to standard type but includes auxiliary relay;
 - .3 audible type with features similar to standard type but includes an audible alarm sounder;
 - .4 isolator type with features similar to standard type but includes line fault isolator.
- .17 Duct Mounting Products of Combustion Detectors:
 - .1 Duct type smoke sensor units with features as follows:
 - .1 addressable photoelectric detector features;
 - .2 duct air sampling tube of suitable required length;
 - .3 magnetic activated test switch;
 - .4 status LEDs;
 - .5 Form C auxiliary alarm relays;
 - .6 remote alarm indicator assembly with LED type lamp and single gang stainless steel faceplate;
 - .7 remote test station for detectors in locations not easily accessible to test.

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- .2 Duct housing assembly consists of an airtight housing mounted on side of duct, and contains sensor base into which photoelectric sensor head is inserted.
- .3 For units located within ductwork as shown on drawings and for units within air intake ductwork, provide weather resistant and corrosion resistant housing complete with integral heater and power supply, and thermostat controller with alarm contacts for monitoring and annunciation of low temperature. Provide system wiring in conduit back to transponder/control panel.
- .18 Audible/Visual Devices:
 - .1 Devices include bell and strobe units. Devices to mount on wall back boxes. Back boxes to be supplied by system manufacturer to suit specific devices and type of installation. Finish colours to be confirmed with Consultant or Owner prior to ordering.
 - .2 Bells to be series 439D with features as follows:
 - .1 24V vibrating bells, 150 mm (6") or 300 mm (12") diameters;
 - .2 alloy steel gongs, cast aluminum base, red enamel finish;
 - .3 sound level of minimum 92 dBA at 3m (10');
 - .4 complete with mounting plate;
 - .5 where recess mounted include for recessed wall box and prime painted grille.
 - .3 Stand alone strobes to be similar to features of combination units specified above but only with strobe features.
 - .4 In finished areas, devices to mount to a 100 mm (4") square, 60 mm (2-1/8") deep, back box. Where devices are to be surface mounted, provide a red finished surface back box with no knockouts.
 - .5 Devices mounted exterior to be complete with "weatherproof" box.
- .19 Wiring:
 - .1 CSA approved and ULC listed wire and cable, approved for fire alarm circuits; with colour coded, insulated solid copper conductors; of type as per local governing electrical code and local governing fire authority requirements; sized and installed in accordance with system manufacturer instructions.
 - .2 Pentair "Pyrotenax" type "MI" ULC listed and labelled and 2 hour fire rated, mineral insulated, copper sheathed, copper conductors for power wiring to and between each transponder/control panel and applications as required by local governing codes and authorities.
- .20 End-of-Line Resistors:
 - .1 End-of-line resistors for standard alarm and signalling circuits, sized to ensure correct supervisory current flows in each circuit.
 - .2 Mount end-of-line resistors on a stainless steel plate suitable for mounting on a standard single gang wall box.
- .21 Isolators:
 - .1 Isolators to be provided in accordance with code requirements and installed as per system manufacturer requirements to isolate/monitor zones, loops, group of devices within building and between buildings.

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- .22 Warranty:
 - .1 Warranty to include following:
 - .1 a one (1) year repair or replacement warranty on components; full labour costs and no deductible;
 - .2 warranty to begin upon Substantial Acceptance of Project, or where applicable, phase of Project; provide extended warranty for system if used during construction stages and to cover period of construction before turn over to Owner;
 - .3 support of an operational remote maintenance capability;
 - .4 repair response times for problems defined as routine to be addressed and corrected within 24 hours, excepting statutory holidays and weekends;
 - .5 repair response times for problems defined as major to be addressed and corrected within 4 hours, excepting statutory holidays and weekends;
 - .6 requirement to have at least one (1) full system of each model provided available in installation area for immediate installation, in case of an entire system failure or catastrophe; such undertaking to be set out in an acceptable plan;
 - .7 manufacturers of major components to provide written confirmation of full warranty, extended warranty and service back-up in case of failure to perform or insolvency of successful supplier.
- .23 System Inspection, Testing and Verification:
 - .1 Include for system manufacturer onsite system inspection, testing, verification and certification work, as per requirements specified in Part 3 of this Section. Note that failure to perform such work to complete requirements specified, may at Owner's discretion, affect progress draws and holdbacks.
- .24 Acceptable Manufacturers (products and work to be provided directly from manufacturer, unless otherwise noted):
 - .1 Mircom Group of Companies (from Mircom Engineered Systems);
 - .2 Simplex Grinnell
 - .3 Chubb-Edwards

PART 3 - EXECUTION

3.1 Installation

- .1 Prior to start of Work as part of shop drawing submission process, review with system manufacturer following:
 - .1 device types to ensure that selected type is suitable for intended application on project;
 - .2 locations of devices to ensure proper operation and coverage are in compliance with requirements of local fire authorities;
 - .3 device mounting heights to ensure proper operation and coverage are in compliance with requirements of local fire authorities;

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- .4 device back box requirements to ensure size and depth suit system manufacturer recommendations for specific devices;
- .5 proposed system sequence of operation.
- .2 Immediately advise Consultant of any requirements of above that may necessitate revisions to design documents.
- .3 Obtain required training from manufacturer representative on any special installation procedures. Install devices and perform work in accordance with the manufacturer instructions and requirements and in accordance to applicable codes of the governing authorities having jurisdiction.
- .4 Provide fire alarm system for building in accordance with issued documents and to approval of local governing authorities. Install, test, verify, and certify system as per latest recognized standards indicated herein, local governing building code and as required by local governing fire authority.
- .5 Work in conjunction with this installation to meet requirements of latest editions of local governing building code, local governing electrical code, ULC Installation Standard CAN/ULC-S524, and any applicable local codes. If any requirements of these specifications are different, omitted or contrary to ULC-S524 Standard, then ULC Standard governs and overrides these specifications, but in no instance will standards established by drawings and specifications be reduced by any of Codes referred to previously. Control units and annunciators to be in accordance to latest requirements of ULC Standard CAN/ULC-S527 "Control Units For Fire Alarm Systems.
- .6 Include for system manufacturer authorized technician to perform system programming work, work within control equipment and final equipment connections. Include for manufacturer authorized representative to perform specified on site software programming sessions for Owner changes, to system after total completion of work and verification of system.
- .7 Provide sequence of operation for fire alarm system as approved by local fire authority and Consultant. Contact Owner's fire Consultant with regards to requirements of sequence of operation and any other requirements of system. Submit sequence of operation and proposed graphic displays to local fire authority and Consultant for review during shop drawing submissions. Refer to additional requirements on drawings.
- .8 Upon completion of Work, demonstrate system to local Fire Department and obtain their approval for complete system.
- .9 Custom program sequence of operation with provisions to allow authorised Owner users to make revisions easily. Following sequence of operation to be considered for Bid Pricing purposes. Exact sequence must be approved by local fire authority and Consultant prior to start of work. Refer to drawing schedule of operations. Submit proposed sequence with shop drawings. Actuation of any alarm initiating device to cause following single stage sequence of operations:
 - .1 audible devices to sound continuously;
 - .2 visual devices to illuminate;
 - .3 zone of alarm condition to be indicated at control panel annunciator and remote annunciator;
 - .4 zone and address of device in alarm condition to be indicated at control panel annunciator and remote annunciator;

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- .5 activation of circuitry to transmit an alarm signal to device(s) provided by others (Owner arranged monitoring company) to send alarm signal to Fire Department or to an outside private protection company; this work to comply with CAN/ULC-S561;
- .6 designated air handling equipment to start-up or shut-down by means of control wiring from control panel to equipment starters;
- .7 release door holders.
- .10 Install control panel and remote annunciators in locations. Mount equipment and connect complete in accordance to manufacturer instructions and requirements. Arrange for manufacturer authorized representative to program system with required sequence of operation. Confirm exact sequence of operation with Consultant prior to programming.
- .11 Where required by Code and/or local authorities, that power and control wiring connections to control panel and annunciators and from control panel to annunciators are to be fire rated, provide fire rated, ULC listed, conductors (MI) to provide code required fire rating.
- .12 Install required devices. Do not install devices in locations that may hamper proper operation of devices including adjacent devices.
- .13 Install wall mounting fire alarm panel pull stations in locations and connect complete. Install flush mounted units in a standard 100 mm (4") recessed outlet box with plaster cover. Coordinate type and size of backboxes and outlet boxes with system manufacturer prior to ordering. Install surface mounted units in manufacturers supplied surface boxes.
- .14 Provide ceiling mounted products of combustion detectors in locations and connect with wiring. Secure baseplate of each detector to a 100 mm (4") outlet box or surface mounted as required. Where applicable, provide wiring in conduit and connections from smoke detector auxiliary relays to door hold open devices. Co-ordinate work of respective trades.
- .15 Generally, do not install rate-of-rise type of detectors in areas subject to sudden changes in temperatures. Confirm with system manufacturer for recommended type of detector for each application.
- .16 Mount each duct mounted products of combustion detector on duct in question and connect with smoke sampling tubes which extend into duct air stream. Install a remote alarm lamp assembly for each duct mounted detector. Wall mount each lamp assembly on a standard 100 mm (4") outlet box as close as possible or practicable to detector. Do not locate duct detectors within 1 m (3') of duct size increaser or decreaser fittings or any duct elbow. Provide wiring in conduit and extend to connect back to system control unit.
- .17 Provide alarm bells on standard device boxes in locations. Ensure that sound levels are in accordance to requirements of applicable local Codes and as required by on site audibility coverage tests. Provide required sound meters and personnel to perform tests. Relocate audible devices to suit, or provide additional devices, as required to provide audibility levels to satisfy testing.

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- .18 Provide strobes on standard device boxes in locations. Ensure that light intensity levels are in accordance to requirements of applicable local Codes and as required by on site coverage tests. Provide required meters and personnel to perform tests. Adjust settings, or relocate devices to suit, or provide additional devices, as required to provide levels to satisfy governing authority requirements.
- .19 In areas of high abuse such as public parking areas, publicly accessible areas, mental health areas and correctional institutions, devices to include vandal resistant, tamperproof and vermin proof features such as guards, fasteners requiring use of special tools and fasteners not exposed.
- .20 Devices in non-climate controlled areas to be weatherproof, corrosion resistant, ULC listed for operation in below freezing temperatures, and as recommended by system manufacturer for use for each specific application. Where electronics are not recommended for cold temperature applications, include for manufacturer recommendations and directions in remotely locating addressable modules in closest heated areas and connecting to respective device in non-climate controlled areas.
- .21 Provide remote annunciator and adjacent graphic annunciator in location. Unless otherwise noted, install in main entrance vestibule. Co-ordinate backbox installation with general trades work of wall structure. Submit annunciator schedule with shop drawings. Verify zone nomenclature with Consultant prior to installation. Provide proposed drawing and sample of graphic display to Consultant for approval before manufacturing.
- .22 Perform required fire alarm system wiring connections to mechanical equipment and other building systems to perform required interrelated functions. Provide required wiring, relays and/or contactors between fire alarm system and various equipment to achieve automatic or manual control of equipment, to perform required integrated to fire alarm system functions. Provide shunt trip breakers as required. Provide ULC listed fire rated conductors where required by local codes and local authorities.
- .23 In addition to wiring connections to fire alarm system components, extend control wiring in conduit to (where applicable):
 - .1 fire protection system piping supervised valves and flow switches for alarm initiation;
 - .2 fire protection system piping supervised valves and flow switches for trouble indication;
 - .3 fire protection piping pressure sensors for loss of pressure trouble indication;
 - .4 fan equipment starters;
 - .5 pumps;
 - .6 dampers;
 - .7 fire suppression systems;
 - .8 telephone system key switch for connection to offsite central monitoring station;
 - .9 security systems;
 - .10 BAS system;
 - .11 genset control panel;
 - .12 devices as shown on drawings.

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- .24 Unauthorized closure of a fire protection system piping supervised valve to cause location of closed signal (audible and visual) to sound and illuminate, and a trouble signal to be transmitted (via a future connection) to Fire Department or to an outside protection agency.
- .25 Low pressure in fire protection piping mains (wet and dry), fire protection system pumps (fire pumps-standpipe system excess pressure pump-sprinkler pump, sprinkler system excess pressure pump) loss of power, or operation of fire pumps to also activate audible and visual trouble alarm as specified above for supervised alarms.
- .26 Provide end-of-line resistors to electrically supervise wiring. Generally, locate end-of-line resistors at ceiling lines above a pull station location. Provide isolators and install in accordance with ULC standards. Properly label and identify. Do not locate end-of-line resistors and isolators in concealed locations. Generally install in equipment rooms.
- .27 Refer to drawing riser diagram. Quantities of components to be as per floor plans and not riser diagram.
- .28 Confirm exact location of components and devices prior to roughing-in. Where applicable, confirm component finishes with Consultant prior to ordering.
- .29 Install wiring in conduit. Perform wiring connections associated with fire alarm system on terminal strips in junction boxes. When pulling wires into conduit, use lubricant and ensure that wires are kept straight and are not twisted or abraded. Neatly secure exposed wires in apparatus enclosures with approved supports or ties. Clearly label and identify wires at termination points. In addition, number wires with Brady Ltd. or Electrovert Ltd. Z-type markers. Colour conductors for each part of system in accordance with system equipment manufacturer recommendations.
- .30 Run alarm signalling circuits (bells/strobes) and alarm receiving circuits (pull stations, detectors) in separate conduits from each other. Perform wiring connections on terminal strips in junction boxes. Paint conduit couplings for fire alarm system in red enamel.
- .31 Where required by local governing codes and/or local governing authorities, provide ULC listed, fire rated conductors (MI) for connections to and interconnections between equipment for life safety applications requiring fire rating.
- .32 Provide engraved Lamacoid identification nameplates for each equipment or wiring housing and secure to front of housing. Exact wording designations and sizes to be reviewed and confirmed with Consultant prior to manufacture.
- .33 Verify nomenclature of annunciator identification with Consultant and obtain necessary approvals prior to ordering.
- .34 Arrange sprinkler system alarm valve alarm zones to be separate from manual station, thermal detector and products-of-combustion detector device zones, which may be connected together into zones.
- .35 Provide required double voltage relays for fire alarm wiring work. Provide double voltage relays, with multiple contacts as required, to shut down designated fans. Arrange relays to be energized at all times from fire alarm system to ensure that they are fail-safe.
- .36 Ground and bond system as required by local governing electrical code and authority and system manufacturer.

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3.2 System Testing & Verification

- .1 Submit to Consultant for approval, proposed schedule for testing and verification of system. Obtain such approvals prior to start of testing. Consultant and/or other Owner representatives to have option to witness all or part of testing and verification work. Notify Consultant and Owner minimum seven (7) working days in advance of testing.
- .2 When system work is complete and ready for acceptance, arrange for fire alarm system manufacturer authorized technician to inspect, test, verify, and certify equipment, including initiating devices, signalling devices, control devices, and wiring. Inspection to comprise of an examination of such equipment in accordance with latest editions of CAN/ULC-S537, for following:
 - .1 to ensure that entire system functions in accordance with sequence of operations on drawings and as specified;
 - .2 to ensure that type of equipment installed is that designated by contract documents;
 - .3 to ensure that wiring connections to equipment components show that installer observed applicable ULC and CSA requirements;
 - .4 to ensure that equipment was installed in accordance with ULC S524 and manufacturer recommendations, and that signalling devices of whatever manufacture were operated or tested to verify their operation;
 - .5 to ensure that supervisory wiring of those items of equipment connected to a supervised circuit is operating and that governmental regulations, if any, concerning such supervisory wiring, have been met to satisfaction of inspecting officials;
 - .6 to ensure that system backup batteries provide sufficient backup power as per local governing building code and local fire authority requirements;
 - .7 to ensure that system audible devices provide alarm sound levels in each area as per local governing building code and local fire authority requirements; be responsible to site adjust tap settings of audible devices as required to achieve required audibility levels;
 - .8 to ensure that system visual display devices are located in areas as per local governing building code and local fire authority requirements;
 - .9 to ensure that each device is commissioned and operable.
- .3 Include for full demonstration to Consultant that system batteries and audible devices comply with specification and code requirements.
- .4 Arrange for local fire authority inspector to review system and Work. Make any necessary revisions and verify. Pay necessary fees and obtain required approval certificate and turn over to Consultant. Perform necessary re-verifications of Work.
- .5 Arrange for manufacturer to supply reasonable amounts of technical assistance with respect to any changes to sub-paragraphs above. During period of inspection and verification, make electricians available to do any required correction work and to assist during inspections.

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- .6 On completion of verification, inspection and testing of system, obtain from manufacturer and forward to Consultant, a verification certificate together with detailed inspection reports listing each and every system component, its location in building and its acceptability. Manufacturer technician to prepare and sign verification certificates and inspection reports, confirming that system is installed, is working in accordance with requirements specified above and that system has been approved and accepted by local governing fire authority.
- .7 Obtain from system manufacturer and forward to Consultant a certificate of liability insurance of minimum amount of Two Million Dollars (\$2,000,000.00), that is to be registered for this project to show satisfactory proof of manufacturer's liability coverage for both their product and personnel.
- .8 Include for re-verification of any failed device repaired or replaced.
- .9 Do not use open flame and/or smoke for testing unless approved by Owner.
- .10 System manufacturer to employ technicians certified and approved for fire alarm system testing and verification by Canadian Fire Alarm Association (CFAA) and Ontario Fire Marshall, as applicable.
- .11 Submit with test reports, copies of valid certification of testing technician.
- .12 Additionally, refer to testing, coordination and verification requirements in Section titled Electrical Work Analysis and Testing and include applicable requirements.

3.3 Integrated Systems Testing of Fire Protection and Life Safety Systems

- .1 Where fire protection and safety systems and systems with fire protection and fire safety functions are integrated with each other, the system shall be tested as a whole in accordance with CAN/ULC-S1001, "Integrated systems testing of fire protection and Life Safety Systems.", to verify that the systems have been properly integrated. All connections to all ancillary equipment shall be tested and verified for proper equipment function. Verification of fire alarm relay contact alone is insufficient. Sample testing is also insufficient for ancillary equipment.
- .2 The Electrical Subcontractor shall retain the services of an Integrated Testing Coordinator (ITC) for all systems that are designed to operate together to achieve an overall fire protection and life safety objective, in accordance with OBC 3.2.10.
- .3 The Contractor shall not act as the ITC. The ITC shall be an independent provider that has been certified by ULC to perform this function and shall provide proof of certification prior to proceeding.
- .4 The Electrical Subcontractor shall cover the costs of the ITC and shall be responsible for coordinating with other trades and is also responsible for scheduling with all affected parties including owners, operators, occupants, inspectors, consultants, installing subcontractors and verifying parties to participate in the testing.

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- .5 The ITC shall provide a project-specific, written, and signed report outlining the testing procedure, implementation of systems integration and necessary functional results in accordance with CAN/ULC-S1001. The systems shall be verified to ensure that they are functioning according to the intent of their design. A cause-and-effect matrix may be used to outline the sequence of operation for the systems integration. Specifically, this integrated testing plan shall outline the fire alarm system's integration with the following equipment and systems:
 - .1 Emergency Generator
 - .2 Sprinkler Systems
 - .3 Fire Suppression Systems
 - .4 Air Handling Unit shutdown.
- .6 Submit the integrated testing plan to the Engineer and include the reporting project close out for subsequent periodic testing including 1 year and 5 year testing per CAN/ULC S1001 Section 8.2. Prior to testing, the Contractor shall provide all occupancy-related documentation to the ITC.

3.4 Training

- .1 Manufacturer trained technician to perform onsite training of each user (including the provision of user guides) prior to project completion to ensure that users are properly trained in the operation and maintenances of system.
- .2 Refer to Instructions to Owner specified in Section titled Electrical Work General Instructions.